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For Primary Schools and Teachers of S1/S2 courses

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Nature's numbers

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89 .....

Can you see any pattern in these numbers? They might look like a strange sequence but you can work out the next one each time by adding the previous two numbers e.g. **0+1=1, 1+1=2, 1+2=3, 2+3=5, 3+5=8, 5+8=13** etc.

This special series is often called Fibonacci numbers. Leonardo of Pisa, to give him his proper title, was an Italian mathematician (1175-1250) who was instrumental in reviving ancient skills, bringing the decimal system to the Latin-speaking world, as well as contributing theories and solutions of his own. In Fibonacci's time, mathematical challenges and competitions were most fashionable. In 1225 a competition by the emperor Frederick II came up with the following problem - if you start off with a pair of rabbits, and it takes one month before a pair of rabbits (one male, one female) can do what rabbits do best and produce another pair (one male, one female), how many rabbits will you have after a year? In ideal circumstances the bunny-pair count would rise in just the number sequence shown by Fibonacci.

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This sequence is sometimes called Nature's Numbers, as they can be found in lots of places in the natural world. The problem above makes assumptions about rabbits, none of which could be construed as being particularly natural - brothers and sisters mating and each litter coming up with one male and one female. So what have these numbers got to do with nature?

Now that Spring is coming and plants are starting to grow, why not go outside and try to find some early flowers. You may notice that the number of petals on any flower head correspond to one of the Fibonacci numbers. Some of the ones to look out for are :-

Figure 1 *- Snowdrop 3 petals*

Figure 2 *- Petunia 5 petals*

Figure 3 *- Tulip - 3 petals & 3 sepals*

Figure 4 *- Try counting this lot!*

Flowers of the Lily family have three petals and three similar coloured sepals and so appear to be six petalled. Bluebells, or *Wild Hyacinth* in Scotland, are also like this.

5 petals - e.g. Geranium, Pansy, Primrose, Buttercup.
8 petals - e.g. Celandine, Starflower, Delphinium.

What look like petals on a daisy are actually separate florets. Wild varieties may have 34 of these whereas cultivated ones in gardens may have 13, 21, 34, 55 or 89 - just try counting the number of florets on a typical dandelion - she loves me, she loves me not .... (Fig. 4)

You may also notice that plant leaves grow in an arrangement which corresponds to the Fibonacci sequence. Looking from above they can be seen to be arranged in a spiral pattern round the stem. Working up the stem, it's not until you get to leaf number nine that one leaf is directly above the first one counted. In this case there are eight leaves in five spiral turns. This arrangement means that each leaf gets the maximum possible share of the sunlight. (Figs. 5 & 6). Using leaves made of card and stems of garden canes to make 3D records of the leaves on the plant encourages your students' careful observation of the arrangement of the leaves (in pairs, singly etc.).

Figure 5 *- Card leaves arranged round a retort stand*

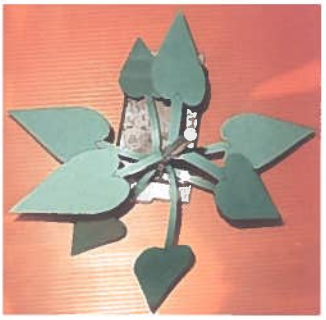


Figure 6 *- Looking from above*

We can find the spiral pattern in seed heads also. It is too early in the year for many plants to be making seeds yet. Try and remember to check out the pattern in the centre of your sunflowers (Fig. 7) later in the summer. You might be lucky enough to find some seed heads left over from last year's plants that you could study.

Pinecones are seed heads from the pine tree and they often show an interesting spiral pattern. If you look carefully you may see two different spiral patterns.

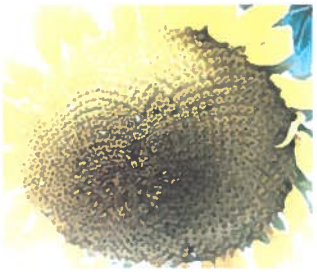


Figure 7 *- Sunflower spirals*

Figure 8 *- Pine cone spirals*

Tip - if you soak a pinecone it will close up, making the spirals easier to see (Fig. 8). This is what makes them useful as weather predictors as they are sensitive to moisture levels in the air.

Figure 9 *- Pineapple spirals*

If pineapples are available and not too expensive you can use them to trace interesting spiral patterns round the outside. You should find that you can see spirals going in clockwise and anti-clockwise directions (Fig. 9). Encourage students to look at these patterns of bumps the next time they are in the supermarket and see if they can recognise and point out the arrangement of spirals to their family members. You can find the same spiral patterns in cauliflowers too, going in both directions.

Figure 10 *- Banana X section*

As a consequence of the fact that plant parts are often Fibonacci numbers, when you cut a fruit in half (across the "equator"), you may find that the internal structure with the seeds also shows the Nature's Numbers pattern. Fig. 10 shows a banana with three sections in the centre. There are lots of common (e.g. apple) and more exotic fruits (sharon fruit) that will also conform to the same number pattern. See how many you find that follow the pattern and how many do not.

The spiral patterns of Fibonacci are not restricted to the Plant Kingdom. One of the most obvious is in the way that some shells grow. Large Nautilus shells show the pattern very well. However as you can see from Fig. 11 garden snail shells and shells found on the beach also show very obvious spiral patterns. These are almost always right handed spirals.

Figure 11 *- Shells from the beach and garden illustrate spirals*

You can recreate this pattern by using squares whose sides are the lengths of the Fibonacci numbers and drawing a quarter circle curve across each square to create a spiral shape, or try making a jigsaw by cutting up a shape like Fig. 12 and getting your students to reassemble it. If you would like an A4 sized copy of the Fibonacci spiral please send a stamped addressed envelope to SSERC, Fibonacci spiral offer, 2 Pitreavie Court, Dunfermline, Fife KY11 8UB.

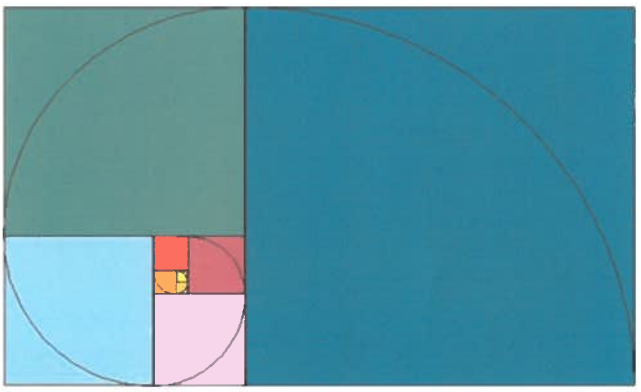


Figure 12 *- Fibonacci squares used to create a spiral*

The ratios between successive Fibonacci numbers is called the Golden Mean - a 'rule' which has been used by artists, architects and photographers in planning their work.

Measuring ourselves

Your students will also be interested in things which apply to themselves, as well as nature, and although there is a great deal of information about fascinating Fibonacci proportions in humans, it is generally not at an appropriate level for most primary children.

Here are some measuring activities they can try out on each other.

Height/width

They will need:

piece of string - 150-180 cm (wool is too stretchy)

metre stick (or two)

two friends

Method

Stand with your arms stretched wide apart.

Have a friend hold one end of the string exactly to the end of your middle finger.

The second friend should stretch the string across your back and to your other middle finger.

Mark that length and measure the length of the string.

Now measure your height and see how the two measurements compare.

Footlength/Forearm

Method

Measure the length of your foot from the heel to the end of the big toe.

If you then measure your forearm (with your arm bent, measure from elbow to wrist), you should find the two measurements to be very similar.

Of course it is much more fun, as well as a test of their suppleness, for your students if they just take off their shoe and lay their right foot along their left forearm! This possibly makes the point without all that tiresome (and potentially inaccurate!) measuring.

The length of your foot can be used to make an estimate of your height, your foot being 15% of your height.

This can be an interesting way to use a spreadsheet package in ICT. If each pupil types in their name and foot length, the correct formula (15/100) will bring up their height in the selected column. They can then check their height "manually" and see if it has worked for them. You may get discrepancies because they are still growing, but it is an interesting activity.

You can also take the opportunity to use a basic graphing package with the computer to provide a record of the range of heights found in the class.

Fun with Forensics

If you would like other activities looking at "personal identifiers" with your class, you may be interested in a workshop on "Fun with Forensics for Primary". These are sessions with activities suitable for 5-14 Guidelines Levels A-D.

They include information on how to use forensic type activities with the children to "identify the suspect" in various scenarios. If you would like to attend or host a workshop please contact Aileen Gray for more details - aileen.gray@sserc.org.uk

Here is a flavour of what is on offer :-

Fingerprints

Look closely at the fingerprints you have made and find out which patterns you can see on your prints.

You could find out which patterns are the most common among the members of your class, or compare your fingerprints to those of others in your family.

Biometrics

Think about the forensic measurements you used, fingerprints, dental patterns and shoe prints.

Which of these would be the most reliable in identifying a suspect?

A muddy clue!

Kim's hobby is making ornaments and jewellery from salt dough and she realises that they could use salt dough to take impressions of the suspects' trainers and see if they can find a match with the footprint in the photo.

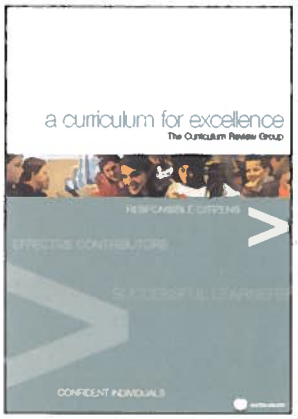
A good impression

"We will have to become detectives and carry out a forensic investigation to find out who has a set of teeth that match the tooth impressions left in the cheese. You can all help and we have everything we need right here in camp."

Who wrote the message?

When the suspects were searched, each one was found to have a black pen. These pens were all different so this gives us a chance to match up the ink in the pen with the ink left in the message.

Changes afoot?



With the current review of the 3-18 science curriculum and the introduction of the Curriculum for Excellence we will have to ensure our science teaching in Primary takes account of the recommendations.

As well as the skills with which you are already familiar from the 5-14 National Guidelines we are being asked to include other skills such as information processing, reasoning, enquiring, creating, and evaluating. Also emphasised is the need to include language, maths and ICT in our science lessons. A few moments of thought will probably reassure you that you are already covering these points and very little change will be required to your current lessons.

The activities in this edition of Science and Technology Equipment News give opportunities to combine maths and science (and of course language) and give a context for using IT databases and spreadsheets. Some of the activities provide data that would be ideal for producing graphs, and depending on age and stage of the pupils, this can be done with or without the aid of the computer.

Components & Materials

Item	Description	Price
593	Miniature motor, 1.5V to 3V, 2mm dia. shaft	30p
614	Miniature motor, 3V to 6V, 2mm dia. shaft. Both motors above can be used for project work but they run at fairly high speeds, some gearing will be required. See worm/gear, item 811	45p
621	Miniature motor, 1.5V to 3V, now with 8 tooth pinion. The open body of this motor makes it ideal for showing how such a motor is constructed	25p
811	Worm and gear, 34 to 1 speed reduction	35p
817	Axles 3 mm dia., nickel plated, round ends, push fit on SSERC plastic wheels, gears and pulleys: 70 mm long, per pack of 4	50p
818	As above but 95 mm long, pack of 4	50p
819	As above but 12 mm long, pack of 4	50p
800	Pack of 100 wheels, 39 mm diameter, assorted colours, 3 mm axle hole	£5.25
820	Worms to fit 2 mm electric motor shaft, pack of 5	£1.00
821	Reducers 3 mm to 2 mm enables gears, pulleys and wheels, to be fitted to motor shaft, per 5	25p
867	Reducers, 4 mm to 2 mm, as above, per 5	25p
868	Reducers, 4 mm to 3 mm, as above, per 5	25p
723	Microswitch miniature, lever operated	40p
822	Plastic toggle switch, low voltage	40p
688	Crocodile clips, red, miniature, insulated	5p
759	As above, but black	5p
788	Crocodile leads, assorted colours, insulated croc. clips at ends,36 cm long. Pack of 10	£1.35
835	2 x AA Cell ('battery') holder	15p
845	2 x C Cell ('battery') holder	20p
729	Battery connector, PP3 type, snap-on press-stud, suitable for Items 835 and 845	5p

Item	Description	Price
789	MES (miniature Edison screw) bulbs 3.5 V	10p
691	MES battenholders for above	20p
866	Lens end lamps, 1.2 V MES. Ideal for use where a narrow, concentrated beam of light is needed. Bargain pack of 100	£3.50
508	LED (light emitting diode) 3 mm, red, per 10	50p
761	LED 3 mm, yellow, per 10	60p
762	LED 3 mm green, per 10	60p
790	3V buzzer (works with solar cell see Item 838)	55p
838	Solar cell, 100 x 60 mm, max 3.75 V per cell	£2.10
839	Solar motor, body 25 dia.12 mm long with shaft 2 mm dia 6 mm long	£1.70
840	Solar pack: one of each solar cell, solar motor propeller (801), and 3 V buzzer - with notes	£3.75
836	Motor mounts, plastic, push-fit with self adhesive base pad for SSERC motors 593 & 614, 10pk	£2.35
801	Propeller, 3 blade, to fit 2 mm shaft. Blade 62 mm long	35p
794	Cotton reels (for making buggies, rubber powered tanks etc.) pack of 20	£1.25
796	Pack of 20 pulleys, 5 of each of 10, 20, 30 and 40 mm diameters.	£3.50
802	Pack of 10 pulleys, 12 mm diameter.	£1.50
837	Ring magnet, 40 mm o.d., 22 mm i.d.	35p
815	Ceramic square magnet, 19 x 19 x 5 mm	15p
823	Ceramic magnets, poles at ends, 10 x 6 x 22 mm	12p
861	Bimetallic strip, 10 cm length	30p
882	Quartz clock movement , dimensions 56x53x17 mm, with wall hanging bracket, Suitable for dial thickness up to 10 mm. Includes plastic hands suitable for dial diameter to 200 mm. Requires an AA battery. See CD Clocks, Newsletter 18	£1.75

This Newsletter and previous issues can also to be found in web page format on the Improving Science Education 5-14 website at:
http://www.ise5-14.org.uk/prim3/New_Guidelines/Newsletters/menu.htm

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