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Mathematics in Children's Books
Notes Compiled From ESM310 Workshops at Burwood — March 2011
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Preamble and Context

In ESM310 Trimester 1 2011 the Week 4 Workshop was on finding mathematics and mathematical thinking in Children's Literature.

I wanted all students to scour their shelves and bring at least ONE of their favourite children's books for possible discussion: picture-story books, chapter-books (novels), poetry, or non-fiction.

How were the students to pick these books?

They were to choose children's books that they remembered really liking, and/or that they like now (even if they didn't like them when they were children themselves). As far as possible, they should be choosing books they read, or had had read to them, before Secondary school.

Some of these books might not actually be for children. For example, they might include novels written for an adult readership such as:
— Daphne du Maurier *Rebecca*;
— H.G. Wells *War of the Worlds*;
- Richard Adams *Watership Down*; or
— Conan Doyle *Sherlock Holmes*.
OR, students might choose children's books they are really keen on, now, as adult readers (possibly as parents, with children of their own, or as child-minders), and as prospective teachers.

They might not have been able to spot any mathematics or mathematical thinking in them, yet.

But I hoped to surprise them.

I was looking forward to seeing their favourites!

However I requested that they please do NOT bring:
• *The Very Hungry Caterpillar* (Eric Carle)
• *Where the Wild Things Are* (Maurice Sendak)
• *The Doorbell Rang* (Pat Hutchins)
• *Who Sank the Boat*, OR *Mr Archimedes' Bath* (Pamela Allen)
as these are just too obvious (valuable though they are).
OR, any of the classic mathematically-connected books discussed by Rachel Griffiths and Margaret Clyne in their *Books You Can Count On*, and other titles.

I had a cunning plan.

If in each class we had one person who would use a laptop to type hasty notes of the classroom discussion of books, at the end of each session that person would e-mail me those notes.

Suppose we were able, in each class, to discuss at least THREE books. Multiply by seven classes — at least 21 books discussed.

By the end of the classes I was planning to compile each of the e-mailed notes into one document, and edit it.

The following final compiled and edited discussion is the result.

I hope YOU will be surprised by the amazing choices of books!
And by the mathematical DEMANDS and OPPORTUNITIES in many of these books!!
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My Personal Recollection of Favourite Books During Primary School Years
As a stimulus for ESM310 students' own reflections, I offered my own (relatively)
short-list of favourite books that I recall reading and re-reading as a Primary-years
child — not necessarily read IN Primary school, during school-time, but certainly
read while I was Primary-school aged (1954-1959).

Robert Louis Stevenson *Treasure Island*
R.M. Ballantyne *The Coral Island*
Richard Lancelyn Green *King Arthur and the Knights of the Round Table*
Mark Twain *Tom Sawyer*
W.E. Johns *The Rescue Flight* (one of many "Biggles" books)
Dorothy Eldon *Snow Bumble*, and *Highland Bumble*
Alfred Bestall, and Mary Tourtel *Rupert Bear Annuals* (with puzzles and origami!)
Ivy L. Wallace *Pookie* and *Pookie Puts the World Right*
Jules Verne *Journey to the Centre of the Earth*
Arthur Mee *Children's Encyclopedia* (in 10 volumes)
Kenneth Grahame *Wind in the Willows*
May Gibbs *Snugglepot and Cuddlepie*; *Scotty in Gumnut Land*; *Prince Dande-Lion*
Carl Barks "Uncle Scrooge" comics
Edgar Allen Poe *The Gold Bug, and Other Stories*
Munro Leaf *The Story of Ferdinand the Bull*
classic **Little Golden Books**, including *Tootle*, *The Saggy Baggy Elephant*, *Good
Morning, Good Night*, *A Year in the City*, *Johnny's Machines*
Roald Dahl *The Gremlins* (his first book: about RAF pilots in World War II): this is
free on the internet, now!
Tarlton Rayment *Prince of the Totem*
Mrs Aeneas Gunn *Little Black Princess*
Hans Christian Andersen *Fairy Tales*, including "The Snow Queen", "The Little
Match Girl", "The Ugly Duckling", "The Emperor and the Nightingale", "The
Steadfast Tin Soldier", "The Seven Swans", and "The Princess and the Pea".
The Children's Treasure House (Odhams Press, 1935)
Ruth Plumly Thompson *The Cowardly Lion of Oz* (one of many sequels by Baum and
others to Baum's original *Wizard of Oz*)
Mervyn Skipper *The Meeting Pool* and *The White Man's Garden*
Kate Seredy *The Good Master*
Rudyard Kipling *The Just So Stories*
Norman Lindsay *The Magic Pudding*
Lewis Carroll *Alice in Wonderland*, and *Through the Looking Glass*
Greek and Roman myths: Nathaniel Hawthorn's books; Charles Kingsley *The Heroes*
G.A. Henty: historical adventure novels: *By Conduct and Courage* (a "Hornblower"-
like tale of Nelson's navy); *The Dragon and the Raven* (Saxons and Vikings)

There could be many more, but these stand out in my memory (and I still have copies
of them).
Also, what about Jean de Brunhoff's "Babar" books, Ludwig Bemelman's
"Madeleine", Alison Uttley's "Little Grey Rabbit" series, Ruth Park's *The Muddle-
headed Wombat*, A.A. Milne's "Winnie-the-Pooh" stories and poems, Anna Sewell
Black Beauty, Daniel Defoe's *Robinson Crusoe*, …
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Notes from the First Class

Book - Nadia Wheatley *My Place* (also TV series) — about Australian history
— when Australia was discovered, by Europeans (Portuguese late 1500s, Dirk Hartog circa 1670, Abel Tasman, Captain Cook at Botany Bay in 1770, the First Fleet arriving at Sydney Cove in 1788), published in 1988, for the Australian Bicentenary.
— Maps, dates, time-line, buildings, streets and changing culture, characters, activities and different locations in the picture book — these are obvious ideas that link explicitly to mathematical thinking and content.

Book - Jeannie Baker *Window* — a wordless picture-book with an implicit story
— each picture is created through use of collage; each picture shows the view through the same window, with the scene looking different as time passes.
Implicit mathematical thinking via historical change, personal growth, classification (consider visual classification in *Where's Wally?* as well as the mathematical logic game "Guess Who" — distinguishing and separating visual features to classify).
Mathematical demand — must think mathematically to make sense of the book.
Also: Book — **Jeannie Baker *Where the Forest Meets the Sea***, and other titles.

- it is important to realise there is more in mathematics, as a curriculum area or body of knowledge, than number and calculations: consider, especially, general processes of mathematical thinking, including problem solving.
- there are two kinds or ways of "doing maths" while reading:
    - formal, deliberate, step by step, pencil and paper (questioning student assists to see whether they understand the mathematical thinking)
    - informal, incidental, mental, subconscious, intuitive.

Books - Mem Fox *Possum Magic*, *Goodnight, Sleep Tight*, and *Wombat Divine*
— looking at *Goodnight, Sleep Tight* — this is a repetitively structured way of having a baby-sitter recite nursery rhymes to a child, hence it contains and needs no mathematics.
— this is different with *Possum Magic*: the little possum, Hush is made invisible by a magic spell, but wants to be made visible again: this leads to a search, a quest for visibility: Hush and Grandma Poss go across Australia, visiting real places: one classroom activity could link the narrative to a map: also link with successive would-be "cures" or recipes that can be cooked or made or tasted in class, and voted on for popularity — there are several mathematical opportunities for a teacher to exploit.

Book - Thelma Catterwell / Kerry Armitage *Sebastian Lives in a Hat*
— the picture on the front page shows an apparently very large hat with a small pink furless wombat: on the last page the much larger fully-grown wombat is seen wearing the same (small?) hat: the issues of growth and relative size immediately arise;
— that is, the story offers a clear mathematical opportunity to consider size — students could even estimate and graph the growth and match this with a time-line.

These obvious, simple tasks may not add a lot to the understanding of the story, but changing sizes and passing time are explicitly central in the book: therefore the mathematical concepts can be made explicit.

This could be a stimulus to classroom measuring activities for a class animal or plant.

Book - Janet and Allan Ahlberg *Starting School*
— the Ahlbergs have been writing children's books since the 1970s. They are famous for *The Jolly Postman*, and also began the outstanding "Happy Families" series early-reader books. Allan has often written stories that are illustrated by other outstanding artists, apart from Janet.
— this book is about what happens to a representative sample of about 8 different children during their first days and weeks and terms of school;
— the overall narrative is an implicit time-line, ending with the end of the school year;
— the story involves a calendar year: seasons, days, weeks, terms: that is, the book evokes many Time concepts that you need to understand if the story is to make sense.

Book - Enid Blyton *The Children of Cherry Tree Farm*:
— this is typical of many of Blyton's stories that present a realistic, everyday portrait of children within their family, experiencing ordinary human events: one of the things that stands out is the way Blyton makes the idea of living on a farm seem really attractive (although you can't smell the dung): even something as simple as eating a crunchy, juicy ripe apple picked freshly from the heavily laden apple tree seems a very exciting thing to do:
— other notable books (series) by Enid Blyton include:
• *The Wishing Chair*, and its two sequels;
• *The Enchanted Wood* (which is actually the FIRST in this series), *The Magic Faraway Tree* (which is the most famous of the sequence, but is actually the SECOND book!), *The Folk of the Faraway Tree*, and *Up the Faraway Tree* (the fourth and least known of the Faraway Tree books);
— there is implicit but essential mathematical thinking in *The Magic Faraway Tre*e sequence:
— a family with children moves away from their city home (the family is experiencing financial hardship): they go to live in a country house with a kitchen garden (being able to grow a lot of their own food will help solve some of their money troubles): the precise location of the country house is not important, it is merely "somewhere": the children need to explore their new and unfamiliar environment: they go out to the surrounding woods: in the woods there is a huge and mysterious tree that seems to be making a strange sound ("Wisha-wisha-wisha, …"): climbing the tree, they go up level by level, meeting a remarkable collection of unusual people and creatures (!): and at the very top there is a rotating platform of lands that change frequently — readers must understand the geometry of climbing the tree and the rotating land at the top, otherwise they will not understand why in each chapter things at the top of the tree change. The children in the book have to find their own explanations for why things happen the way they do at the top of the tree: as readers attempt to solve this mystery, or understand the children's theories, the readers are thinking mathematically — it is not calculation that is involved, but reasoning and deliberate (explicit) thinking spatially.
• the **"Famous Five"** and **"Secret Seven"** — these classic Blyton series involve groups of children (often some of them members of a family) encountering a mystery, that their surrounding adults either do not see or are reluctant to become involved in, and setting out to solve the mystery: mathematically, this involves all the problem solving of an adult detective adventure story.
• **"Noddy"** books — these are actually much better than may be realised, particularly the first six in the series, during which Noddy grows up. In the early books there is a

clear narrative sequence: first, Noddy is made (carved), and unaware of himself; he runs away from the wood-carver (why?), and accidentally finds (literally runs into) Big Ears, and then goes to Toy Land: the second book shows how Noddy tries to make a living: in the third and fourth books this continues: in the fifth book Noddy goes to school, and in the sixth book Noddy and Big Ears go on a holiday to the beach: even though from then on, in many ways, Noddy continues to be child-like, he has gone through much of a life-sequence, and is a more or less established, responsible citizen of Toyland earning his living as a taxi driver. There is much potential to investigate maps and time-lines to clarify where things are happening in terms of what Noddy is doing. The formal trial, at the end of the first book is a good example of the way logical reasoning occurs in a story: evidence is presented, and official conclusions are based on that evidence.

Incidentally, the stereotypical negative criticisms of the "Noddy" books — Noddy and Big Ears are allegedly gay, policemen like Mr Plod are belittled, and gollywogs are racist stereotypes, allegedly — are largely misguided. Importantly these criticisms fail to see the stories, as originally published, with the innocent minds of young children, and ignore the many gollywogs who are good, or the occasions when Mr Plod is seen to be a fine member of the constabulary.
Recent editions of the classic 24 "Noddy" books have removed any of the supposedly objectionable material, anyway. (There is even a new 25th Noddy book!)

Book - Allan Baillie *Drac and the Gremlin*
— this is an interesting prize-winning picture-story book: the TEXT is a story of science-fiction fantasy, rather like a mix of *Star Wars* and *Lord of the Rings*: in contrast, the PICTURES show children playing in a suburban backyard with their cat and dog: the reader must make coherent sense of the TWO separate stories, the real actions and the narrated actions. For example, the supersonic spaceship — imagined — is actually a tyre swing, etc.
The mathematical thinking required here is like cracking a code: things are named in the text and they represent something else. The story challenges the reader to decode this.
Interestingly, Baillie's book was published in 1988. Exactly the same device (ordinary children's pretend-fantasy playing, with a fantasy narrative and realistic pictures) was first used by Russell Hoban (illustrated by Colin McNaughton) in the series "The Hungry Three", including *The Flight of Bembel Rudzuk*, and *They Came From Aargh!*, and *The Battle of Zormla*.

Book - Paul Adshead *One Odd Old Owl*
— this is, or could be used as, a counting book as you could perhaps even assume from the title.
— the book is about a snail who can't go to sleep because the owl snores: he enlists the help of others to make noise, counting up in the number of animals.

Mathematics in this book? Counting, exploring the rhyming pattern and other verse patterns, understanding the solution of the narrative puzzle — the book itself gives the total of all the animals involved at the end.

Similarly, on the topic of COUNTING BOOKS, consider those where the possible counting does NOT really matter to the story, such as Theo Le Sieg (although the

verse patterns and word play can be considered mathematically) ***Ten Apples Up On Top*** (a reader COULD count the successive apples, but this is not actually needed to understand the verse.

Contrast this with Le Sieg's ***Wacky Wednesday***, in which the story actually challenges the reader to FIND the stated number of wacky things. How? The child-narrator in the book wakes up and sees one wacky thing in the room: the reader has to look at the picture and identify what this one wacky thing is, as the words do not say: and on the next page the child sees two wacky things, and so on. If the reader ignores this invitation to search for X-number of wacky things, there is nothing left in the story. Hence the reader really needs to count to follow the story and find the things.

When you look at any counting book, consider: is the counting essential?

Incidentally, Theo Le Sieg is a pen-name for Dr Seuss, which is a pen-name for Theodore Geisel. Another Seuss pen-name is Rosetta Stone. Who or what, or where and when, is "THE Rosetta Stone", and why is this an important name? (Considering how much we owe the Egyptians — including our use of an alphabet that was derived historically from the Egyptians' use of picture-hieroglyphics to represent spoken sounds in words — being aware of the Rosetta Stone is an important part of being culturally aware, and a socially responsible citizen of the world.)

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Notes from the Second Class

The Doorbell Rang **– Pat Hutchins**
Titch – Pat Hutchins (Size, comparison)
— Hutchins is famous among mathematics teachers for the rich mathematics potential of her many picture-story books, including ***Too Many Clocks***, and **Changes, Changes**: however, these two actually use mathematical thinking and language in telling the stories: the title character Titch is concerned about his small size (happily, in time, he grows). The children who hear the doorbell ring are waiting to share the tray of cookies — as more people arrive at the door, the answer to "How many cookies will we each get, if we share fairly?" changes. Fortunately Granny arrives with more cookies, so no one is disappointed. Hutchins' stories are always appealing, and her simple illustrations are attractive and sensible.
— ***Rosie's Walk*** almost cries out for a sketch map to show where Rosie goes, and what happens, step by step, to the fox who tries to catch Rosie.

In the Night Kitchen **– Maurice Sendak**
— this dream-fantasy story explains why we have cake to eat every morning (well, some mornings, maybe, we can hope). Why? Because Micky went journeying, and brought milk back from the Milky Way (actually a giant glass bottle of milk), helping the bakers in the night kitchen. (These bakers all look like Oliver Hardy, the tubby conceited would-be heroic and delightful simpleton in the classic film comedy duo Laurel and Hardy — Laurel is the tall skinny shy cowardly simpleton, but he does not appear in Sendak's book. As a child, Sendak greatly enjoyed Laurel and Hardy, so this is a deliberate homage. Kurt Vonnegut also likes them, but that is another story.)

— there is an obvious mathematical opportunity for recipes: cake, bread; and a class survey of what IS actually eaten by class members for breakfast (cake? bread? rice? roti? cereal? congee?), and what students might LIKE to have for breakfast.

— the city-scape that stands behind the bakers, and the night kitchen, and over which Micky flies in his bread-dough flying-suit in a bread-dough propeller aeroplane (an old plane without a built-in starter engine, because Mickey has to spin the propeller to start the motor) is made of gigantic everyday kitchen utensils and grocery packages and bottles: this suggests a search for and classification of the REAL item for what the item looks like.

— the cityscape made of everyday objects also suggests an investigation of scale: if Mickey is, for example, 1 metre tall, how big is the Milky Way bottle?

— at a more superficial level, the story is about Time, specifically night-time.

A Pet for Mrs Arbuckle – Gwenda Smyth

— Mrs Arbuckle travels the world (maps!) searching for possible animals (classification), and finding that some animals are not good as pets (logical reasoning), with a narrative time-line of events: plus, how is the plot-question eventually answered, and why?

Who Sank the Boat? And *Mr. Archimedes' Bath* – Pamela Allen

— like Pat Hutchins, Pamela Allen is famous for the rich mathematical potential of many of her stories. What do you know about Plimsoll Lines? Archimedes' Principal? Displacement of a volume of water? Buoyancy versus gravity?

—**Pamela Allen's** *Is Your Granny a Goanna?*, for example, has end-papers (inside the front and back covers) that show an aerial view of the train journey — almost a picture-map!

— Incidentally, *Who Sank the Boat?* is virtually identical in story **to John Burningham's** much earlier *Mr Gumpy's Outing* (1970): person after person, and animal after animal CAN go for a ride with Mr Gumpy IF they do not muck about, but, as things turn out … (Mr Gumpy should not be confused with **Gumby**, the heroic little plasticine boy, a hero of Claymation TV cartoons.) Mr Gumpy has similar difficulties during a car trip — but that is another story.

Charlie and the Chocolate Factory — Roald Dahl

Where is the mathematics?

— consider the probability (Chance) of finding a Golden ticket

— a timeline could be very helpful: several things that are narrated in the middle of book actually happened at beginning of timeline, for example, Willy Wonka found the Oompa Loompas years before the Golden Ticket search for an heir to the wonderful factory, which is what the book is about: and what is the back-story of Charlie Bucket's parents and grand-parents?

— logic: what the Oompa Loompas say in their songs, about children, greed, gluttony, TV, and so on, matches the children the songs are satirizing: later the terrible doom that each of the "bad" children meet relates to that child's "badness" and the predictions of the Oompa Loompas' songs: if you do not make the logical connections you are reading the book very superficially.

— later (in the sequel book) the movement in three spatial directions of Willy Wonka's Great Glass Elevator is an opportunity for spatial mathematical thinking, and maybe some diagrams.

— students may compare the book with the two film versions: the Gene Wilder film is earlier, and in many ways a less faithful version of the book's story, but may be closer to what Dahl had in mind (who wrote the screenplay?): the Johnny Depp version is more extreme in its art-work and in Depp's mannerisms as "Willy Wonka", but this version may be more faithful to the details of the published story, and the Oompa Loompas and their activities: analysis, and comparison: use tables for detailed descriptive and comparative summaries.

The BFG (The Big Friendly Giant) — Roald Dahl
— size, and comparison are obvious opportunities, here, as a child is compared with a giant who struggles to fit into the child's room.
— there is a kind of code in the wordplay behind the BFG's outrageous vocabulary: this is a little like Lewis Carroll's portmanteau word-play, where two words are smashed together to make a new meaning (such as "slithy" = "slimy" + "lithe"): what his words mean can be decoded by analyzing the components that make the words (albeit, with some transformation)

George's Marvelous Medicine – Roald Dahl
— a series of increasingly ghastly recipes appear in this dreadful book: there can be few popular children's books by a respected author that actually outline ways of getting violent revenge on a (deservedly?) detested elderly relative, culminating in MURDER!

Are We There Yet? — Alison Lester
— distance
— time
— mapping
— any book with a central theme of TRAVEL necessarily presents opportunities for mathematical thinking and activities, and may even involve explicit demands.

The Tale of Peter Rabbit – Beatrix Potter
— Beatrix Potter's books have many mathematical opportunities implicit in them
— the illustrations show real (not imagined) plants: classification;
— the buildings shown in her pictures are real buildings, and can be classified, architecturally, and possibly be used as a stimulus for drawing building plans, or bird's-eye views
— the locations shown in the pictures are of real places, usually around the Lake District where Beatrix Potter lived as an adult: Google searching may find photos of the places Potter illustrated
— each of Potters's stories presents a problem that needs to be solved: problem solving
— a time-line can usefully identify the sequence of writing the stories, and locate Potter within her historical era: late Queen Victoria, Edwardian and World War I, and later.

The Princess and the Pea – Hans Christian Andersen
— size comparison is a central theme: the pea in question is tiny, relatively speaking, compared with the very tall stack of eiderdowns that are used to make the princess's bed

— sensitivity is the other (satirical) issue: only a REAL princess could be so sensitive that she tosses and turns all night and is black and blue from bruising after trying to sleep on the bed in which a pea has been hidden: class survey of sensitivity (e.g. can blind-folded students feel the difference between a $2 and a $1 and a 10¢ coin, or a $5 $10, and $20 note?

The Rainbow Fish – **Marcus Pfizer**
— division, as sharing out, of the troublesome rainbow scales, is the solution to this simple, but visually attractive story of socialising.

Wombat Stew and *Wombat Stew Cookbook* – **Marcia K. Vaughan**
— in the same way as Dahl's horridly amoral *George's Marvellous Medicine*, Vaughan's wily wombat and his friends are able to get rid of the dingo by concocting a vile potion, supposedly "wombat stew"
— perhaps surprisingly, this book, with its bilious cookery actually led to an enjoyable children's recipe book of real foods that are not just edible but tasty!
— there is much scope for mathematical thinking in any book that includes discussion of special foods, or growing food, or cooking and recipes.

Edward the Emu and *Edwina the Emu* – **Sheena Knowles**
— Edward is bored with being an emu, apparently, and sets out to be like the other animals in the zoo: classification, analysis, comparison, summary tables, Venn diagrams
— verse patterns: rhythm, and rhyme
— in the sequel, Edwina is expecting a clutch of ten eggs to hatch: but as lady emus do, Edwina leaves the egg-warming to Edward, while Edwina goes in search of a job that suits her special talents: more verse, more classification and analysis.

A Nice Walk in the Jungle – **Nan Bodsworth**
— Miss Jellaby takes her class for a nice walk through a remarkable jungle, little realizing that the line of pupils following her is being followed by a hungry boa constrictor who is progressively eating one pupil after another until …
— sequence: and reversal or undoing of the sequence (like a mirror-image, or inverse operation)

Charlotte's Web – **E.B. White**
This is possibly one of the greatest children's books ever written, and a pretty good book for adults: an excellent annotated edition by Peter Neumayer is available, greatly adding to the appreciation of the details of the story, White's life as publisher, editor, author and farmer, the brilliant illustrator Garth Williams, and how the book was made
— money arises as an explicit mathematical demand: Fern and Avery at the County fair have small amounts of money to spend: the corresponding opportunity is for students to work out ways of spending their own money at the Royal Show or similar event
— geometry is implicit in the book: the shape of the Ferris wheel at the County Fair, the farm fences, Templeton's burrow, the crate for Wilber, the spherical egg sac, the stick-letter spelling in the web
— this a book where the seasons of the year matter, and there is progress through a whole calendar year

"Goosebumps" books
— The books in this popular series deliberately start with a more or less everyday situation that quickly begins to seem strange, spooky and outright threatening: fortunately these are not like the regrettably popular modern books about actual vampires and werewolves and other ghastly fantasy monsters: the spookiness in the "Goosebumps" books is all might-have-been-scary
— each "Goosebumps" book presents a problem: something eerie is happening: what does it seem to be, and what is it really? —problem solving

***The World's Biggest Sandwich Ever* – Rita Gelman**
This is a straightforward tall tale of a mysterious little man who challenges two children to help him make the biggest sandwich ever, for no particular reason: it is very popular with young readers: read reviews at Amazon.com.
— As with any book whose theme is size, on a gigantic (or a miniscule) scale, the mathematical opportunities are obvious: scale diagrams, actual measurements in the playground, role play
Perhaps surprisingly, a very similar story is about a jam sandwich that is made for a very genuine purpose:
— http://en.wikipedia.org/wiki/The_Giant_Jam_Sandwich
***The Giant Jam Sandwich* — story and pictures by John Vernon Lord, and verses by Janet Burroway**: the story of how, one long hot dry summer, in Itching Down, four million wasps flew into town. Try Googling the title to find online lesson plans based on this book! The transcript of John Vernon Lord's discussion of how he made the book is fascinating (http://www.fulltable.com/vts/g/gjs/g.htm).

Guinness Book of Records
— a fascinating, and persistently popular collection of extremes
— the measurement challenges are obvious, surely!

***The Lion, the Witch and the Wardrobe* – C.S. Lewis**
— C.S. Lewis's **"Chronicles of Narnia"** present many opportunities for mathematics, and some actual demands.
— most editions include a map of Narnia, which is essential for mentally imaging where the children travel as the story unfolds
— classifying creatures and characters: humans, talking animals, mythical creatures, monsters: "good" and "bad": try a Venn diagram to sort these: where would you put Edmund, and why?
— narrative timelines: Earth-time begins around 1940, during World War II: where does Narnian-time begin, and where does it end in the story? And how old are the children at the start of the last chapter and at the end of the book?

Looking at a book:
Some books, may explicitly force us, or **demand** from us, actual mathematical thinking, or else we miss crucial aspects of the book's meaning because our reading is too superficial.
Other times, there may be an implicit **opportunity** or stimulus to do some mathematical thinking.

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Notes from the Third Class

Mathematics in children's books is more than mere calculations
Mathematics may be explicit: a reader would be required, as an essential part of the reading, to do some actual formal, written mathematics, using pencil & paper, perhaps drawing diagrams or maps, writing numbers and calculating distances or money or times, constructing tables, or family trees, or time-lines.

OR

Mathematics in children's books may be implicit: a reader could be stimulated to think informally, mentally, intuitively.

We have potential in many (fiction) books to consider:
    WHO?
    WHAT?
    WHERE?
    WHEN?
    WHY?
    HOW?

These key questions almost always require some kind of mathematical thinking.

For example, identifying WHO can include:
— Classifying, as an example of mathematical thinking.
Similarly, HOW and WHY? Can include:
— analysing and understanding cause & effect, reasons, explanations: these are all aspects of logic, or mathematical reasoning.
— Exploring a character's biography, and family relationships.

Hairy Charlie and the Pumpkin **– Jackie French**
— there may be no explicit mathematics in this picture-story book, but it has implicit maths: in particular it includes a PUMPKIN RECIPE: quantities, step-by-step method, timing, ingredients.
— Growing, size, measuring, graph of growth
— 1D vine, 2D "mat of vines", 3D solid volume of vines.

Jackie French is also the prolific author of many historical novels about important Australian events and people: the geography and history immediately present explicit and implicit mathematical stimulus!

Monty **– James Stevenson**
From the Amazon.com review: Arthur (a frog) and Doris (a duck) and Tom (a rabbit) depend on Monty (an alligator) — that is, they walk on him: he swims them across the river on the way to school, and they've begun to take him for granted ("Let's see some speed, Monty!"). Then one morning Monty declares himself on vacation — maybe for "years and year". The others try some alternatives — a row of turtles, a seesaw as catapult, standing on Arthur's back while he swims — each ending in an unwelcome splash, but the last gives them more respect for their erstwhile (one-time) friend, who reappears.

— Challenge to cross a river
— Problem solving: mechanisms; sequence of turtles as stepping stones
— Implicit: the illustrations do not provide a large view of the problem context, which might almost be a picture-map: readers need to imagine the diagram of the "gap" which is the problem:

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Bank    →    River →    Bank
   |
   V
 Vacation spot
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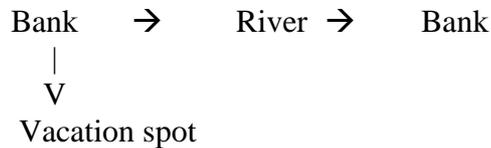
Meg & Mog – **Jan Pienkowski**
The Meg and Mog (and Owl) stories (and TV cartoon series) are essentially for pre-school children, but may be used as revision and stimulus for simple exploration of:
— geometric shape-hunting
— colours
— cause and effect.

There's a Hippopotamus on the Roof Eating Cake – **Hazel Edwards (illustrated by Deborah Niland)**
This is the first book in a long series of a troublesome hippopotamus who is often in unusual places doing unusual things.
What may not be obvious is that the hippo is an imaginary friend who fearlessly does the things the little girl (who is imagining the hippo) would like to do.
— word-play? Let's pretend? Imaginary friend/creature as a code for some actual reality
— relative size and scale: just how big is a hippo, imaginary or otherwise?

Incidentally, Deborah Niland, as well as her twin sister Kilmeny Niland, is an author and illustrator: for example, Kilmeny's *Two Tough Teddies*. They are the daughters of D'Arcy Niland, an Australian adult author, and Ruth Park, the better known adult novelist (*The Harp in the South*, *Poor Man's Orange*), writer of autobiographies, and children's author — *The Muddle-Headed Wombat*, *Playing Beatie Bow*, *Callie's Castle*, and many others. Ruth's husband, D';Arcy Niland, was himself, a notable Australian adult novelist.

The Cat in the Hat – **Dr. Seuss**
The action of *The Cat in the Hat* is fast and furious, and essentially pre-school or early reading: naturally, because that is what it was written for, with a strictly controlled vocabulary, but to be much more amusing than the drearier, comfortable middle-class readers, such as the "Dick and Jane" series, or Australia's (Victoria's) classic "John and Betty". Nonetheless, for children to properly understand the action and the humour, it helps to think mathematically:
— Thing 1 & Thing 2: these two "helper" cats are named by numbers, albeit at a pre-school level of counting
— logic and its reversal: the cat persistently breaks rules, misbehaving and taking risks: things begin in their proper place, are taken out of their proper place, and are then, or eventually, re-placed.
In the sequel *The Cat in the Hat Comes Back*:
— Little Cats A, B, C, etc.…are listed in alphabetical order

— the Cat taking a bath presents a mathematical opportunity: consider the surface area of pink in the bath, then on the mat and the wall and the clothes, and eventually as a volume of snow — these are spatial and measurement ideas, similar to seeing a 1 litre can of paint being used to make a long narrow line, or a square area, or a rectangular brick.

The Little Red Caboose – Little Golden Book
In this classic Little Golden Book the poor little caboose, at the end of the train is never (!) waved to by the children who happily wave at the big engine at the front, and the early carriages and wagons. But one day …
— slope is a central part of the plot, as is gravity
— sequence is important, as is comparison of size or significance.

Tiddelik
Several picture-story book versions of this traditional Aboriginal legend exist: it is the story of the drought that is caused by the giant frog Tiddalik drinking all the water, and how the thirsty animals try to get Tiddalik to release the water. (How do you get all the water there is out of a giant frog?)
(This is loosely reminiscent of the voracious tiger in Judith Kerr's classic picture-story book ***The Tiger Who Came to Tea***, who, at the end of his enormous meal drinks all the water in the tap — can you imagine that? Even the Norse demi-god Loki, of Viking mythology, could not drain the fabulous Horn of Plenty!)
— volume
— sharing
— climate/seasons/drought
— problem-solving

***We're Going on a Bear Hunt* – Michael Rose**n
— sequence: narrative and story pattern
— location
— path
— reversal of sequence
= simple mathematical thinking

***Spot* – Eric Hill**
Very simple, but enjoyable, stories about a puppy who has a caring mother close at hand: more for pre-schoolers, but with scope for exploring basic spatial and other ideas, such as vocabulary and concepts of "in, on, near, far, behind, under, over", …

***"Baby Sitters Club"* series**
As with many series books ("Nancy Drew", "Hardy Boys", "Saddle Club", and so on) these present:
— natural, everyday life-event problem-solving
— numeracy (= using Primary school mathematics, spatial thinking, and other mathematical thinking outside a mathematics classroom)

***Elmer the Patchwork Elephant* — David McKee**
This is the first of a popular series about an unusually colored elephant who does NOT fit in, but by a blend of personality, cleverness and luck, he wins his way to acceptance, and later teaches his elephant friends further lessons of social tolerance.

— patterns, tessellation, surface area
— similarities and differences: classification

The Slimy Book – **Babette Cole**
— catalogue of slimy things: classification
— word-play and alliteration of sounds in the initials of words

Our Magic Beach and *Rosie Sips Spiders* and *Clive Eats Alligators* – **Alison Lester**
— Classification, shapes, seasons
— Sentence patterns: examples and counter-examples: sound patterns such as alliteration

The Eleventh Hour – **Graeme Base**
Graeme Base is probably the outstanding Australian author who ALWAYS offers his readers explicit mathematical challenges in his narrative and illustrations. Riddles, codes, hidden images, puzzles, knots, tessellations, and much more!
The Eleventh Hour is a mystery: Wikipedia states this clearly:
— "Horace the Elephant holds a party for his eleventh birthday, to which he invites his ten best friends (various animals) to play eleven games and share in a feast that he has prepared. However, at the time they are to eat—11:00—they are startled to find that someone has already eaten all the food. They accuse each other until, finally, they're left puzzled as to who could have eaten it all. It is left up to the reader to solve the mystery, through careful analysis of the pictures on each page and the words in the story."
Ditto *Animalia*, and Base's other books!

Heidi – **Joanna Spyri**
This is a great classic of children's literature (albeit, like Alcott's *Little Women*, originally written for adults), and ought to be read in full in the original (translated). It is an example of a book that has probably never been properly made into a film that is either faithful to the book, or as good as the book, although some of the TV serial versions are acceptable.
— classification: readers need to understand the differences in life-style of the historical period of the story
— food and recipes: the melted cheese on bread that Heidi is served by her grandfather is a variant on the classic Swish dish of raclette (like fondue on a slice of bread!)
— shapes: Heidi has a ROUND window in her attic in her grandfather's mountain barn-house, and Grandfather is a wood-carver
— seasons: any book where snow and deep winter are an important feature requires simple mathematical thinking about times in a calendar year
— location: Heidi is an orphan from a Swiss valley village: her grumpy grandfather lives high on a mountain, in self-imposed exile from society (problem: why?): his close neighbour is Peter the goat-herd, and Peter's blind grandmother: Heidi is sent to Frankfurt (in Germany) to be a companion for the crippled rich girl Clara (problem: what is the cause of Clara's disability?)
— learning to read: Heidi is unschooled, but Clara's grandmother helps her, and later Heidi teaches Peter to read: although we think of reading (and writing) as being exclusively about LITERACY it requires a great deal of mathematical thinking (left, right, top, bottom, spatial orientation, sequencing, spatial shape recognition, …

There Was an Old Lady Who Swallowed a Fly
The book version of this traditional folk song obviously invokes comparisons of size.
Also: by **P. Crumble** *There Was an Old Bloke Who Swallowed a Chook*
— There was an old bloke who swallowed a chook. I don't know why he swallowed that chook . . . By cripes, that's crook!
And
— by **P. Crumble** *There Was An Old Lady Who Swallowed A Mozzie*
— size matters: in the famous advice, "never eat anything bigger than your head".

The Berenstain Bears' Picnic and *The Berenstain Bears' Honey Hunt*, and other **"Berenstain Bear" books by Jan and Stan Berenstein** (part of the "Dr Seuss Cat in the Hat Beginning Beginners Book" series)
— spatial location, paths, and picture-maps: most of the Berenstain Bear books contain a pathway of adventures (or unexpected mishaps) as the Papa Bear (a boastful accident-prone dimwit) tries to show his loving son how to do things, like where to have a proper picnic, or where to find honey, or how to go hiking and camping, or how to use Christmas presents like a sled, skis and ice skates: typically Papa Bear comes to grief and shows all the wrong ways, but the little Bear happily learns what NOT to do: often the almost-bird's-eye view of the successive locations of Papa Bear's disasters is almost as good as an actual picture-map.

The Gruffalo and *The Gruffalo's Baby* – **Julia Donaldson**
A mouse journeys in search of food. Each time the mouse is threatened by a bigger animal that wants to eat him, the mouse warns the bigger animal that there is a fierce Gruffalo on the prowl, wanting to eat that bigger animal. The mouse successively describes the Gruffalo's fierce horns, teeth, claws, and so on. When, however, the mouse meets the Gruffalo - a ferocious monster-creature that the mouse had believed to be no more than a defensive figment of the mouse's imagination - …
— sequence of encounters
— attributes that combine into the whole creature:compare this with the traditional story of the Blind Wise Men who meet an elephant, and each describe a feature of the elephant — like a tree trunk, a wall, a snake, a rope — and have no idea of the actual elephant
— repetitive pattern of events
— increasing levels of threat
— mirror-image reversal of events, and balancing out at the end
— verse patterns and rhymes

Our School Fete — **Louise Pfanner, illustrator Kim Gamble**
This Australian picture-story book is a seemingly simple story of an ordinary family preparing to contribute to the local school fete: Mum is working on the jumble sale, Dad is working on the Produce stall, the older children are working on a House of Horrors stall, and the baby of the family …
The actions and pictures include:
— a map of the fete;
— illustrations that show locations that can be identified in the map;
— time-line of activities leading to the fete itself;
— money and budgeting;

— modelling and pattern-making for the House of Horrors spiders web and magic wands, and other items for sale.

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Notes from the Fourth Class

Kenneth Grahame - *The Wind in the Willows*
This is one of the greatest children's books, ever! It is also an outstanding book for adults!! It has been illustrated by many people, but possibly the best of these is Ernest Shepherd, who also illustrated the "Christopher Robin and Winnie the Pooh" books by A.A. Milne. Shepherd created a map for the countryside of *Wind in the Willows* and Toad's adventures.
Many Primary children would have had this read to them at one point. This is a typical example where the film and TV versions are inferior to the book.
The standard questions we ask of almost any (fiction) book lead quickly to mathematical thinking" WHO? WHAT? WHERE? WHY? HOW?
— Is there mathematics in this book?

Consider two short excerpts:
FIRST
Rat is preparing for an attack on the weasels and stoats who have captured Toad Hall, the manor house of his friend Toad: he is dealing out a personal arsenal: "here's a sword for ….here's a sword for ... " – PARTITIVE DIVISION! (Division as sharing is a form of mathematical thinking.)

SECOND
Rat and Mole are at the tired end of a long winter ramble when suddenly Mole catches a hint of the small of his old burrow-home, and is overcome by a desire to see it again (he has been staying at Rat's Riverbank home ever since the Mole finished Spring cleaning, and popped up to the sun for a rest — at the beginning of the book). The excerpt (find it, and read it yourself) describes in considerable detail the approach to Mole's house, with the front garden and decorative features, and the front door and door-pull. The description is so clear that several illustrators have used it to guide their pictures of Mole's house — Ernest Shepherd's illustration is possibly the most detailed.
As you read Grahame's description, you informally, spontaneously, mentally (intuitively) think mathematically. You create in your mind what you know about these words
• map-imagery and spatial thinking
— going down the hole and tunnel: the flicking of a light
— orientation in space (right and left, near and far, higher and lower)
— time-sequence, and direction
• classification: the book contains several different kinds of humans and creatures:
— ordinary humans: judges, policemen, washerwomen, the jailer's daughter, and so on
— River bank animals: Rat, Otter, and others who live by the river
— field and forest animals: sheep in the fields
— Wild Wood animals:
    -- benign animals (rabbits)

    -- dubious animals (untrustworthy, impudent foxes: dull cart horses)
    -- naughty or working class animals (ferrets, weasels, stoats)
    -- Badger

The more we think about the rich details in the book, which includes thinking mathematically, the greater our experience of the book is.

Madonna – *Mr Peabody's Apples*

Excerpt from the Amazon.com review:

"Set in a tiny American town, Madonna's story features the big-hearted and much beloved Mr. Peabody, an elementary school teacher and Little League coach who dedicates his summer Saturdays to the local losing team. The kindly teacher seems to savour life the way he savours his weekly apple - taking pleasure in the little things. One weekend after the game, Tommy Tittlebottom watches Mr. Peabody take his apple without paying for it. The following weekend Tommy calls in reinforcements to witness Mr. Peabody's transgression. By the next Saturday, Mr. Peabody's apparent theft has become grist for the Happville rumour mill and no one comes to Little League practice. These moments truly highlight Long's talents as an illustrator - the handsome Mr. Peabody (part Harry Connick, Jr., part Robert Redford) comes to life on the page, his disappointment as palpable as that of Billy Little, the young boy who idolizes him. A simple explanation puts the rumours to rest, but as Mr. Peabody points out in a poignant demonstration, small talk can often lead to big trouble for everyone."

A seemingly simple home-town moral story like this might seem to have little need for mathematical thinking. But there are examples of mathematics naturally in the story:
• fractions — Mr Peabody gives the example of cutting a pillow in half, as the first step in making a moral point
• as Mr Peabody is explaining something he invokes a kind of code (or representation) — a feather stands for a person (metaphor)

John and Betty — a Primary "reader"

In the early 1950s this was the first book in a new Victorian Education Department reading scheme. It is superficially similar to American readers in the "Dick and Jane" series, or to some of the British series of Ladybird readers of that era. Life was more innocent then. It was natural and generally acceptable that John has a drum and plays with toy soldiers and a truck, while Betty has a doll and a doll's pram. Nowadays we read such a story and recognize gender stereotypical characters. However, contrary to the stereotypical limitations, both John and Betty can skip (or jump rope, as the Americans would say), and they happily skip together. (Gender equality!)

The second book in the series was *Holidays*, followed by *Playmates* — moving from the brief sentences in each page of John and Betty to a more coherent narrative of everyday (suburban middle class White Anglo-Saxon) family life.

Readers such as these are usually representative of the things most children experience. Whether it will ever be possible to have such readers in a multicultural society is unclear.

John and Betty is sensitively discussed by Juliet O'Conor in *Bottersnikes and Other Lost Things* (Melbourne University Press, 2010).

— O'Conor's beautifully illustrated book is a critical, and nostalgic, survey of great Australian illustrated children's books, exploring issues of social class, gender,

childhood stereotypes, racial stereotypes, and much more. It discusses John and Betty, noting its gender limitations, and its vivid illustrations.

— We can explore a book such as *John and Betty*, using a two-column table to summarise, compare and contrast the distinguishing features of John the boy and Betty the girl: this could also be displayed as a Venn diagram of gender similarities and differences.

A Tip For Teachers: Keep your old children's books: hold fast that which is good!

Paul Jennings *Unreal*, *Unmentionable*, and many other *Unsomething* books, and *Round the Twist* – also turned into a popular TV series

Paul Jennings was a lecturer in Special Education, at Burwood State College, and later at Warrnambool, both of which were ancestors of Deakin University! As a Remedial Literacy expert he was especially interested in students who were struggling to learn to read. He particularly wanted to encourage boys who were uninterested in learning to read, particularly boys beyond the lower Primary years, to learn to read. The usual first readers were obviously written to be interesting to 5 and 6 year-olds. Big tough semi-literate 10 year-olds were repelled by "baby books". So Jennings decided to tell stories that would captivate these struggling reluctant older students. Often he did this with a hint of naughtiness — such as mentioning bums and toilets and picking noses. Or he used a wicked sense of twisted humour to spice the reading experience.

Also Jennings has written *Paw Thing*, and *Singenpoo* — stories of a clever cat.

Is there mathematics in Jennings' books?

— Location often matters: many stories are set by the sea.

— There is usually some sort of twist in the plot, or a twist in the meanings of words: these challenge you to think logically, to understand what has been twisted, and how.

NOTE: the way Jennings challenges his readers with a surprise twisted ending to each story resembles the twists that Roald Dahl includes in his adult short stories. Some of these have been used for the same purposes: engaging older reluctant readers by reading the first pages of the story to the struggling readers, and giving them the last page to read for themselves.

Morris Gleitzman — *Misery Guts* and *Worry Warts*, and many other children's novels

Gleitzman writes from a child's point of view, with a child's sense of humour. The child who is nicknamed "Misery Guts" lives with a family that is struggling to make a living in grey England. When they migrate to Australia to start afresh, they hope to find the glamour of the tourist posters, but encounter cyclones, crocodiles, stinging jelly fish, falling coconuts mosquitoes …

— any story that includes moving from one country to another, and from one culture to another, can stimulate exploration of similarities and differences: these can be summarized in a table, and displayed in a Venn diagram.

Shirley Barber: author illustrator of many "fairy" books, the "Martha B. Rabbit" series, and many others.

Barber's popularity is undeniable. Her illustrations are richly detailed and coloured. Her stories fit in the traditions of the sentimental fairy tale, or talking animal genres.

It should be noted that, good as her work is, the art is derivative because it clearly resembles earlier book-art by people such as the Australian author-illustrators Pixie O'Harris, and Peg Maltby, or the British illustrator-artists Ivy B. Wallace (also an author in her own right), and the earlier work of Arthur Rackham, for example. Similarly Barber's stories tend to be simple, however enjoyable.

— to the extent that aspects of everyday life (even the everyday life of a rabbit called Martha, or of fairies) can stimulate some mathematical thinking (cooking, shopping, dress-making, house-decorating, travelling, gardening, and solving everyday problems), Shirley Barber's books have the potential of mathematics in everyday life (numeracy).

The Cherry Dress — **Elizabeth Honey**

Sally wears her beloved cherry-patterned dress every day, until she outgrows it. So it is passed on to Lucy, then Maria, and then Fiona, and when it is all worn out, it goes to Fiona's teddy. Sally's father takes a photo of Sally, Lucy, Fiona and Ted to send to Grandma, who made the dress for Sally many years before.

— Although the necessary mathematical thinking is simple, the topics of growing up, relative size, passing time, generations, and family relationships, are crucial to understanding the story.

Enid Blyton – " *Fireside Tales*"

This appears to be a collection of short stories that Blyton had published separately in earlier books.

Some of them are in the genre of 'Simple Johnny' stories, in which a simpleton character misunderstands some everyday instruction, and the resulting logical twist in misinterpretation is amusing: for example, **Peggy Parish's** *Amelia Bedelia* is a naïve character who is a house-maid and cook: on one occasion is asked to prune the bushes (so she takes a packet of prunes and sticks a prune on the end of each twig on each bush), on another occasion she is asked to make a sponge cake (so she chops up a sponge and mixes it into the cake batter) — fortunately Amelia Bedelia is a brilliant cook, so she is always forgiven her mistakes. As another example, Noddy, in his first book, is about to build his very own House For One, and he suggests putting the roof up first, in case it rains, so that he and Big-Ears can continuing building the rest of the house without getting wet. **Constance Egan's** *Epaminondas* is another "Simple Johnny" character, as is Dummling in the Brothers Grimm story of the Golden Goose.

— to understand why a "Simple Johnny" story is funny the reader needs to understand the correct meaning of the instruction, and recognize the twisted logic of the misunderstanding.

In many traditional Fairytales there is a problem and a solution – a solution which is morally satisfying and logically satisfying. Recognising the logic of the solution requires informal mathematical thinking.

Hans Christian Anderson — *The Little Match Girl*

This is one of the world's saddest stories. The Little Match Girl is so poor she is struggling to sell matches to passers-by in the street to earn a very meager living: standing on the footpath in the freezing snow and cold of deep winter, on New Year's Eve she is reduced to her last few matches. Perishing from the cold, as a desperate measure, she lights her last matches, one after another, each one for its tiny, brief warmth and glow. Match by match, she sees visions, of warm fires, hot food, a huge

Christmas tree, and her dead grandmother. She is found, next morning, frozen, but smiling.
— Perhaps some favourite stories do not offer either a mathematical demand or opportunity: as stories they simply, deeply, appeal.
— Wherever the time-sequence of events in a story make passing mention of other places and other times, these can be clarified with a time-line or a sketch map.

The Steadfast Tin Soldier — **Hans Christian Anderson**
A toy lead soldier loves a ballerina doll made of paper. A sequence of dreadful adventures happens to the tin soldier, mainly because of a malevolent troll who lurks under the floorboards. Eventually the battered tin soldier is thrown into the wood-stove and melts, and a sudden draft blows the ballerina doll in after him. The next morning the remains of the melted soldier are discovered in the ashes of the stove — in the shape of a heart.
— the narrative sequence of events can be displayed on a time-line, with brief statements of cause and effect for each event
— this sequence can also be plotted on a sketch map, from location to location.

The Ugly Duckling — **Hans Christian Anderson**
 – in this classic tale Time, and the passing seasons, are crucial aspects of the narrative
— also consider the similarities and differences between ducklings and cygnets, and grown ducks and grown swans.

Joanna Cole (illustrated by Dirk Zimmer) *Bony-Legs*
Excerpt from the Amazon.com review:
"Sasha's aunt (her mother never would have done such a thing!) sends her to Bony-Leg's house in the woods to fetch a needle and thread. Along the way, Sasha is kind to a hungry cat and a skinny dog, feeding them her lunch. She greases a creaking gate at the entrance to Bony-Leg's cottage. Once she gets to Bony-Leg's, Sasha is locked in the bathroom, and told to get nice and clean so Bony-Legs can eat her up. The cat and the dog that she fed on her way to Bony-Leg's give her a mirror, a wooden comb and let her escape without a mew or a bark. The kindly oiled gate lets her out without a squeak. With the help of these others, and the use of her own cleverness in figuring out how to use the mirror and the comb, Sasha escapes. And Bony-Legs …?"
As a variant on traditional fairytales, with a malevolent relative (substitute parent) and a threatening witch or ogre — such as in *Hansel and Gretel* — this is a story of kindness repaid — cause and effect.

Bony-Legs is surprisingly similar to another variant of traditional tales, Alan Garner's *The Princes and the Golden Mane* (Garner happens to be one of the greatest children's writers, perhaps, ever), and illustrated by Michael Foreman (who is a superb illustrator, and has also written some fine stories of his own).
Garner's plot is:
— a king is jealous of his daughter's beauty, so he locks her away;
— she falls in love with a stable-boy, but the stable-boy must flee or risk being killed by the king;
— the princess had two children, and the king was so angry he gave her to a beggar;
— as she was leaving the palace, the princess was helped by a horse with a golden mane; and so on …

— along the way, the princess escapes on the horse's back, fleeing the beggar, who is really a giant ogre (cannibal), by throwing a comb on the ground (and it grows into a forest of bronze briars, or rose-thorns or blackberry prickles), and throws a mirror down (which becomes a huge deep lake).

And, eventually, they all live happily ever after.

It is a profound, macabre story of revenge, redemption and a kind of resurrection.

But is there any mathematical thinking in it?

Maybe only the logic of the transformations (like a visual-image-object code):

— mirror into lake;

— comb into thorn forest;

and so on. But there are lots of these transformations!

One student recalled a favourite title: ***Bear's Day By the Beach***

Perhaps this is **Susanna Gretz's *The Bears Who Went to the Seaside***, one of several books about a household of brother-like bears, one who is always hungry, another always reading, another always busy with activities and imagination, and their spotted Dalmatian dog, Fred.

— Susanna Gretz's "Bear" books benefit from making a clear repetitive summary, in words and pictures, of the bear's name, each bear's colour, each bear's character, and each bear's favourite activities, as well as the dog, Fred.

— one of the stories involves the bears moving house: the story and illustrations almost amount to an implicit map of how to get from their old house to their new house (without getting lost).

Several students recalled their enjoyment of ***AFL Club story books***, that were full of football statistics and club information:

— the mathematical opportunities are obvious, apart from also considering the geometrical designs of AFL jumpers and club badges.

Also consider the AFL-based books, written especially for (male) footy-minded reluctant readers in the **"Specky Magee" series**, Felice Arena and Garry Lyon: see the official web-site: http://www.speckymagee.com.au/books.cfm

For the other football codes (there is more to "football" than Aussie Rules!), consider, for example, Martin Waddell's **Napper Goes for Goal**, and **Napper Strikes Again**. Waddell, who is best known for his rich picture-story books, such as *Once There Were Giants*, and *Can't You Sleep, Little Bear?*, and who also writes outstanding children's novels under the pen-name of Catherine Sefton, was himself a professional soccer player, and lamented the lack of books that soccer-mad boys could read — hence "Napper"!

What about either of the Rugby codes, or basketball, netball, tennis, hockey, etc.?

Who knows what may exist that could be found?

It is possible to read about a football match in a superficial way:

- now the Red team have the ball, and they move around, and then the Blue team tackles, and then the Blue team kicks a goal.

Alternatively we can read the same match-play description and mentally follow the descriptive and technical words, for example:

- the Red ruckman knocks the ball to his rover who stab-punts it to the forward pocket who narrowly misses the mark, and is tackled by the Blue centre-half back: then the Blue centre-half soccer-kicks the ball away, and follows it and scoops it up, and then he runs and bounces the ball towards the middle of the ground, and then handballs to his rover on his left who runs and bounces, evading the Red's defending full-back, and the Blue rover kicks through the now-undefended open goal posts.

The technical terms for the players' positions and roles in the team, and for the specific actions and tactics in the play all convey distinct information about the playing. Reading this kind of explicit verbal description is like listening to football or cricket commentary on the radio: an experienced reader or listener can easily, mentally, follow the action from player to player, around the playing field, with a vividly imagined sense of space and player interaction. This involves considerable mental spatial thinking, as well as continuing mental analysis of cause-and-effect interactions - lots of mathematical thinking, albeit, subconscious, informal, and intuitive.

Similar comments apply to any book that includes substantial description of sport, or other action (such as cricket, tennis, mountain climbing, car races and chase, horse-riding and wagon-training, infantry combat, naval and sailing manoeuvres, flying and aerial dog fighting). We could read, superficially, and understand only that "something happened". Alternatively we can mentally follow the action as a sequence of events in time and across or through space - turning right or left, climbing or flying up, diving down, reversing, corkscrewing, looping or rolling. This more thorough comprehension requires mathematical (spatial; and logical) thinking!

Anne Frank's book of short stories: ***Tales From the House Behind***, and Anne Frank's own ***Diary of a Young Girl***, kept when her family was in hiding from the Nazis, in Holland.
It is impossible to read Anne Frank's diary or stories, and understand them properly, without being aware of their geographical location (Amsterdam, after the Frank family fled Germany following the rise of Hitler's Nazi Party), and their historical time (the years leading up to and including the Nazi occupation of Holland, and the collection and transportation of Jews to concentration camps). Several specific historical events are mentioned in the diary, including the Allies' invasion at the beaches of Normandy in early June 1944.
This also includes understanding as precisely as possible the plan of the multi-storey house and warehouse with shop in which the Franks and two other families were hidden, and the secret bookshelf-doorway that concealed the entrance to the annexe, the "house behind".
It also requires understanding of the stringent rationing of food, and the kinds of food and recipes cooked, as well as rationing of clothes, and the shortages of other domestic necessities.
Because the Frank family was Jewish it also helps to have some familiarity with Jewish customs and their location in the calendar.
(When I first read the diary of Anne Frank I needed the footnote in the Pan paperback edition that explained the conversion of kilogram quantities into the Imperial pounds and ounces that were used at that time in Australia. That point of mathematics was,

for me, a demand. Now it is an opportunity for readers who only know the metric system of units.)

Frances Hodgson Burnett *The Secret Garden* (often filmed or made into a TV serial)
This is one of the great children's novels of the Twentieth century. Burnett also wrote ***The Little Princess*** (also often filmed) and ***Little Lord Fauntleroy***, and ***The Lost Prince***.
Her stories are almost always a variant of the classic "Cinderella" story.
This fairy-tale type is a mathematical opportunity to analyse and clarify the narrative structure of "Cinderella":
— a young girl (or boy) is orphaned or loses a parent;
— a malevolent (possibly jealous) substitute parent appears who mistreats the girl (or boy);
— the girl (or boy) must endure hardship and maintain her (or his) own inner goodness, even while doing menial tasks;
— a special good-parent substitute (fairy godmother, or godfather) assists the girl (or boy);
— eventually the girl's (or boy's) goodness is recognized by other good characters, and the malevolent character is exposed and disposed of,
— … and they all (most of them) live happily ever after.

NOTE: Analysing the narrative themes, characters, relationships, supernatural elements, and plot resolutions in traditional tales (folk tales, fairy tales, myths, legends), and exploring the structure of traditional tales requires mathematical thinking.
In fact, for fiction, generally, identifying a Beginning, a Middle, and an End is just one kind of structure. This often needs some mathematical thinking about which event comes where or when, for the real time-flow of the story to be grasped.
A similar remark applies to analysis of non-traditional stories.
— It is impossible to understand or appreciate *The Secret Garden* without having some sort of imagining of England, and the story's location in Yorkshire: the specific location is crucial because of the countryside, and the local dialect spoken.
— other geographical understanding is needed: the young girl in the book is initially orphaned in India, and sent back to more distant relatives in England: cultural differences between the girl's life and experiences in India, contrasted with her new situation in England, are important in the book: recognizing these differences entails some mathematical thinking.
— it is also impossible to read and understand *The Secret Garden* without paying attention to the passing seasons (Time), or the kinds of plants (Classification).
— as with many other frequently re-printed classic stories, a book like *The Secret Garden* (which has also been issued in a scholarly Annotated version, with biographical details about Burnett and her writings) offers the opportunity to investigate and compare (or survey favourites) different illustrators, from Charles Robinson and Ernest Shepherd, to many others.

"*Nancy Drew*" series, and "*Clue*" series [books based on the classic logic board game *Cluedo* — called *Clue*, in North America), and "*Hardy Boys*" series, and so on

— all detective stories involve demands of logical reasoning, identifying and connecting clues, establishing cause and effect, motives, opportunities to commit a crime, who to suspect, and why …

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Notes from the Fifth Class

L.M. Montgomery – *Anne of Green Gables*
Lucy Maude Montgomery wrote several more "Anne" books, as well as another excellent trilogy about "Emily of New Moon" — a sequence of books about a young girl who grows up to be a writer, and who eventually solves an old family problem — it is also a story of a search for treasure and happiness.
The "Anne" (and "Emily") books are some of the best children's books ever written! It is impossible to read them, now, in Australia, and understand them, without paying attention to:
— location: Prince Edward Island, a small province in Canada; and
— the period: at the start of the Twentieth century (life was very different then, before computers, TV, modern phones, antibiotics, supermarkets, aeroplanes, feminism, contraception, …).

NOTE: Montgomery was writing in a genre of children-in-a-family that had unexpectedly became very popular because of **Louisa May Alcott's** *Little Women*, followed by *Good Wives*, *Jo's Boys* and *Little Men* — loosely based on Alcott's own family, during the American Civil War. Around the same time as Montgomery, **Edith Nesbit** in England wrote several children-in-family stories, including *The Railway Children*, and *The Treasure-Seekers*, and *Five Children and It* (the latter two having several sequels). Similarly in Australia, **Ethel Turner** wrote the classic *Seven Little Australians* (and sequels), and Mary Grant Bruce wrote a long sequence of **"Billabong"** books, starting with **A Little Bush Maid** (1910). All of these, and others in this genre, need informal mathematical thinking to understand the specific location, the life-style and culture within a different historical era, and family relationships.

J.R.R. Tolkien – *The Hobbit*
Unlike *The Lord of the Rings*, which Tolkien wrote for himself and his Oxford friends (the Inklings — see the book by Humphrey Carpenter for details — C.S. Lewis was a friend of Tolkien and an Inkling!), Tolkien wrote *The Hobbit* for his own children.

Like Kipling, with *The Just-So Stories*, Tolkien illustrated *The Hobbit* himself, and included special details to engage his children (and other readers) in the almost-real fantasy world he was inventing (Tolkien refers to this inventing as "subcreating" — in respectful deference to the one god who, according to Tolkien's Catholic faith, is the only power that can genuinely create), including:
— a detailed map of the journey "there and back", which is the subtitle of the story;
— riddles told underground;
— clues to finding treasure;
— runes (non-Roman "letters", based on Norse or Viking writing);
— non-English languages, including dwarvish and elvish.

It is possible to read *The Hobbit* and pay little attention to these special details, leaving the story as a superficial fantasy trek and adventure. But, if the mathematical opportunities presented in *The Hobbit* are grasped, this resulting mathematical thinking will enrich the story greatly, and pave the way for the enjoyment of the similarly rich and challenging story *The Lord of the Rings*, and the prequel or backstory to both *The Hobbit* and *The Lord of the Rings*, *The Silmarillion*).

Gerald Durrell – *My Family and Other Animals*
Although Gerald Durrell (writer, traveller, zoo-keeper, and animal collector) wrote this real-life story for adults, it is easy reading for a middle-Primary student, as are his other books about collecting animals for zoos. Durrell did also write stories expressly for children, such as *The Talking Parcel*. Gerald Durrell appears in *My Family and Other Animals* as the young child Gerry, in this autobiographical account of his family, and other animals, shortly before the start of World War II, on the island of Corfu (between Italy and Greece).

It is possible to read the book superficially as a very amusing series of anecdotes — it is indeed a very funny book!

But the story is greatly enriched if we understand WHY the Durrell family were living in Corfu, rather than in England. This was the era of the Great Depression, and the family lacked the income of a working father, and Corfu was a very cheap place to raise a family.

It also helps to understand the different life-style of that era — no telephone, TV, CDs, computers, supermarkets, and so on.

It is also essential to pay attention to the great variety of plant-life and wild-life that Gerald explores as a young would-be animal collector.

Incidentally, his brother Lawrence grew up to be one of the best novelists of the Twentieth century, although Gerald's books (and TV travelogues — similar to David Attenborough's early animal-collecting documentaries) were probably more popular than his brother's novels.

Gerald Durrell was a pioneer in the conservation of species! He was the first to see that a zoo could sustain species that were in danger of extinction in their natural habitat.

There is a lot to think about, mathematically, in his books and life.

Lewis Carroll — *Alice in Wonderland* and *Through the Looking Glass*
It is possible to read the "Alice" books as simple dream-fantasies, with one wacky event and character after another. Dreams are like that.

Maybe this is the best way for children to enjoy them. But there is so much mathematical and other challenge in the stories (and in **Carroll's *The Hunting of the Snark*** — a first-class, and very amusing nonsense poem) that detailed annotated editions of the "Alice" books have been published by Martin Gardner (one of the great mathematical writers and popularisers — imagine a David-Attenborrough of mathematics!), and others. These annotated editions are, for adults, the best way to re-read the "Alice" stories.

Until **Gardner's *Annotated Alice*** can be read (during Secondary school, perhaps), Primary readers can enjoy the:
— twisted logic;
— word play and verse patterns;
— strange names and characters (horse-flies and bread-and-butter-flies, for example);
— identification of nursery rhyme characters;
— the sudden changes of size as Alice eats or drinks magic food;
… and much more.

Incidentally, the Walt Disney feature-length animation mixes both "Alice" books as though they are one story, which they are NOT. But at least the art is based on the original classic illustrations of Tenniel, who himself based his work on the original sketches by Carroll. By contrast, the Tim Burton film (with Johnny Depp as the Mad Hatter) uses the raw fantasy materials of Carroll's books, but wildly distorts the

original. It is not a sequel to Carroll, but rather like re-reading the "Alice" stories after they have been put through a paper shredder and reassembled, or turned into a pack of character cards, shuffled, and dealt out to create a new story. (Beware of film versions of books! In my opinion, with few exceptions, the film of a book is rarely as good as the original book. Some exceptions are *Mary Poppins*, *The African Queen*, and *Babe*, originally Dick King-Smith's *The Sheep Pig*.)

Frank Baum – *The Wizard of Oz*
This is the first of many "Oz" books. It was Baum's attempt to create an American alternative to the European fairy tales of the Brothers Grimm, and others.
(Warning: our familiarity with the famous Hollywood film of *The Wizard of Oz* should not distract us from the fact that the start and end of the film radically alters Baum's original story, even though the middle parts of the film faithfully reflect most of the action in the book. Dorothy's journey, in the book, is NOT a dream: nor is the black-garbed post-mistress an anticipation of the Wicked Witch of the West!)
Is mathematical thinking needed in reading *The Wizard of Oz*?
— Almost any story of a journey suggests the possibility of making a sketch map of the route, and places seen and the characters met along the way: the Wikipedia entry for Baum and Oz includes a detailed map that shows not only the geography of Oz, but also the neighbouring countries that appear in sequel stories.
— Almost any story that uses fantasy and introduces unusual characters benefits from a considered compilation of the different kinds of characters, their behaviours and distinguishing features.
— The traditional posing of problems, and searching for and achieving solutions for problems is a feature of most fairy tales, even the story of Oz.

During the 1970s and 80s, ***"Choose Your Own Adventure"* stories** were very popular.
Interestingly, few of them were written by serious authors, but John Marsden, the author best known for *So Much to Tell You …,* and the teenage future war sequence that begins with *Tomorrow, When the War Began*, wrote a choose-your-own-adventure — *Cool School: You Make it Happen*. (Pan Macmillan, 1995).
Some of these choose-your-own-adventure books included some actual mathematical activities, such as rolling a dice to decide an outcome. (This is a natural consequence of writing stories that read like a Fantasy-Role-Play game such as Dungeons and Dragons, where dice often dictate the chance-determined fates, and character-attributes, of fantasy-role-play characters).
— It is possible to keep an explicit pencil-and-paper record of progressive choices, while reading a choose-your-own-adventure book: eventually this might result in a pathway or tree-structure that reveals the path to a happy ending, while identifying the paths to doom, destruction and misery.
— It is also possible to record the effects of different strengths of character-attributes, such magic power, physical strength, psychological charisma, physical health or illness or injury, or adequate food or water supplies.

Hans Christian Anderson — *The Little Mermaid*
The original story by the mid-Nineteenth century Danish fairy tale author is rather different from the popular Disney Studio feature-length animation — there is no music, to start with, and little humour. In fact the original is a dark story of witchcraft and immortality struggling with love and human mortality, and pagan forces in

conflict with Christian morals and beliefs. Moreover, at the end of the original story the Little Mermaid dies — her mermaid-human body is dissolved in the foam of the sea as the witch's magic spell is broken. But in a mystery quasi-pagan way, the spirit of the Little Mermaid is offered a chance at redemption and resurrection by spirits of the air.

Is there mathematical thinking here?

— Informally, a reader must grapple with the definitions of mortality and immortality, with the crucial distinctions between life in the sea and life on the land breathing air: this is VERY different from the last section of **May Gibbs' *Snugglepot and Cuddlepie***, in the undersea world of Little Obelia, where air-breathing gumnut creatures can survive under water without drowning: Anderson's story is very different, also, from **Charles Kingsley's *The Water-Babies***, where Tom the unlucky and mistreated chimney sweep seems not to drown when he falls into a river — or perhaps he is alive only in the way that a soul lives on after death. (Kingsley was an Anglican church minister, so putting purgatory and resurrection into a children's book about a child's was a natural thing for him to do.)

Magic School Bus — **Joanna Cole**

From Wikipedia:

— "*The Magic School Bus*, and related sequels and spin-offs, including a cable-TV series, is a series of children's books about science written by author, Joanna Cole. They feature the antics of Ms. Frizzle, an elementary school teacher, and her class, who board a magical school bus which takes them on field trips to impossible locations such as the solar system, clouds, and the past. The books are written in the first-person from the point of view of an unnamed student in 'the Friz's' class. The class pet, Liz, a lizard, accompanies the class on their field trips."

It should be obvious that books written by a teacher will (deliberately!) present many implicit opportunities as well as explicit demands for thinking mathematically, and scientifically, and in other classroom-related ways.

Where's Wally? — **Martin Handford**

(***Where's Waldo***, in the USA — and other names in other countries, but very popular!)

The narrative may be light (or non-existent). But the mathematical challenges are obvious. Finding Wally with his distinctive horizontal red-and-white striped sweater and beanie requires careful visual (geometric and pattern-identifying) exploration. There is a clear opportunity for using coordinates at the sides of the page to specify Wally's location:

    — street-directory or Battleships type: letters and numbers;
    — mathematical (x , y) coordinates;
    — latitude and longitude; or
    — clock-face bearings, reading from the centre of the picture, with a specified distance along that bearing.

Try Googling for *Where's Wally*, and check the background details in **Wikipedia** — did you know about Wally Watchers, for example?

The visual searching for the IMAGE of ONE of Wally in each picture resembles the corresponding visual searching for a NUMBER of images in the successive pages of **Peter Pavey's *One Dragon's Dream***. In the dragon's dream, the dragon journeys to strange places where, for example, when "Three Tigers told him off", the double-page

spread contains objects in triples. (That is, every type of object always comes in threes, on this double-page spread, but the total of three is not always easy to spot.) Similarly when "Five cranky kangaroos hopped around him and fenced him in", the images on the page come in quintuples, but not always side by side.

This is a very special counting book, among an over-supply of banal would-be counting books that actually need, or demand, no actual counting (!), in that actually doing the counting is a major requirement (or challenge), for example, on the nightmare page of triples, if the reader spies ONE tube of paint, where are the other TWO tubes? The experience of reading and searching Pavey's remarkable book is incomplete without successfully finding all the n-tuples on page n.

By contrast, with many so-called counting books the actual count of objects on a page is not important for understanding or appreciating the page or the story, and in many books of the counting-up or counting-back type of "Ten little thingummies toddling in a line, One of them evaporated, then there were nine, …", the actual number that might be found by counting is actually declared in the text on the page! Why count, then?

Similarly in **Bruce Whatley** and **Rosie Smith's** *Alpha Quest* and *Whatley's Quest* the reader is directly challenged by the author-artist to find all the words for images on the successive pages that begin with the alphabetical letter that is featured on that page. For example: Eagle and Emu, the Goldfish in Gliders, the Knight, the Pirate Pig, the Violent Viking — and there are picture-clues that lead the reader to find hidden treasure! (An appendix lists all the words that can be found.)

In all of these *Where's Wally* search-the-illustration-type of books, the requirement to focus on visual distinctive features requires a great deal of informal, intuitive, but focused mathematical thinking.

Philip Pullman – *"His Dark Materials"*
This is a prize-winning fantasy sequence about parallel universes that includes *The Golden Compass* (originally published in Britain as *Northern Lights*). It is also familiar as a Hollywood film (with Nicole Kidman and Daniel Craig).

The story is a dark fantasy vaguely reminiscent of **Susan Cooper's** *The Dark is Rising* sequence. Pullman is famous for his criticism and dislike of C.S. Lewis's **"Chronicles of Narnia"**, and the way Lewis very deliberately, but not always obviously, based aspects of his "Narnia" stories on Christian ideas. It is odd, then, to realise that Pullman very deliberately based his own fantasy-adventure series on John Milton's epic Christian poem *Paradise Lost* (which tells of the struggle between the good Angels, such as Michael and Gabriel, and the Fallen Angels, such as Lucifer — flung out of Heaven and condemned to the fires and torment of Pandemonium, a word invented by Milton to describe the place where demons are everywhere).

— Any book that is based on another invites careful analytic comparison of source and variant;

— Fantasy stories with mysterious invented fantasy creatures require careful analysis of the creatures and their attributes.

— Stories with a quest, or a struggle of good versus evil, or Dark versus Light, require thoughtful recognition of the logical steps that lead from the initial problem and the successive struggles and battles, to the eventual conclusions and victories.

— Stories that travel from one place to another, or one universe to another, invite the making of sketch-maps to explain and clarify who goes where, and when, and how, and why.

Antoine D'Exupery – *The Little Prince*

This is a short spiritual fable, illustrated by the French author (a pioneering air-mail and air force pilot who was killed in action during World War II). The story is about the pilot crash-landing in the desert in North Africa, and meeting (or hallucinating) a child who is dressed in a nightgown and later in the formal Eighteenth century clothing of an aristocrat - the Little Prince. Many readers interpret the Little Prince as a Christ-like child, including his temptation by a Satan-like snake, and his acceptance of being poisoned by the snake (mimicking the crucifixion). The Little Prince tells the pilot he has come to Earth from a distant small planet, and along the way met several other strange people on other planets. These encounters give the pilot-author a chance to deliver moral lessons about life.

From the first page the reader is challenged to think mathematically. The author-pilot introduces the story by explaining that he is not a good artist, and proceeds to demonstrate his child-like artistic lack of skill by drawing a picture of a boa constrictor that has eaten an elephant. The massive elephant-shaped bulge inside a hungry boa constrictor looks like an innocent drawing of a brown hat. So the pilot-author-illustrator then draws a cut-away version to show the elephant that is inside the constrictor. Later, the illustrations of the strange people on their planets, and the Little Prince standing on his planet, challenge the reader's understanding of "up" and "down", because these planets are so small there is almost no room to stand on them. The fact that these mini-globes have the same spherical shape as the Earth also links with a reader's need to think carefully, in three-dimensions, to understand the idea of "up" varying depending on whether we stand in China, at the North Pole, or on the Equator, or at Hobart.

Beyond the need to classify the strange characters, the Little Prince's gardening also introduces the reader's need to understand (by classifying) the differences between a rose, a baobab tree (a very strange kind of tree, but an actual tree), and also small volcanoes.

This is a unique book, and although it is unlikely to appeal to everyone, it ought to be experienced at least once. (There is a strange musical film version of the story, also.)

Louisa Alcott – *Little Women*

This is the classic late Nineteenth century story of a family of young girls growing to womanhood, and their mother, and relations and neighbours, in New England, in the United States, during the American Civil War. (Three excellent film versions exist.)

Mathematics?

- recipes and housekeeping and domestic management routines;

- clothing and needlecraft;

- hobbies and sports (these Americans even play cricket!);

- literature that is referred to (including Charles Dicken's **Pickwick Papers**, and John Bunyan's **Pilgrim's Progress**), as well as the girls' writing (melodramatic pseudo-Shakespearean plays, and household newspapers);

- listing the cast of characters and their family relationships;

- time-line of events, including seasons, and the American Civil War (how many years are included in the book, and its sequels?).

A.A. Milne – *Winnie the Pooh*, and *The House at Pooh Corner* (the sequel)

- the Ernest Shepard illustrations include a picture map that shows the locations of places and events, including the Hundred Aker Wood, Owl's house, Rabbit's burrow, the North Pole that Pooh discovers (what is an "aker"?);

- classification: which of the characters actually have real brains, and which just have fluff in their heads?

- the geometric analysis of the line segments that make a capital letter A, and the construction of a stick house for Eeyore;

- the three-dimensional adventures of Pooh floating beneath a balloon (not a helium balloon - this is a pretend-play kind of adventure, and, naturally, we have to suspend our scientific disbelief to enjoy the story) in the blue near a bees' nest: Pooh eating too much for elevenses underground and getting stuck in Rabbit's burrow-tunnel;

- the reading and misreading of footprints in the snow that might be a spotted or herbaceous hephalump (or is it a woozle?);

- surveying people to see what they like to eat (what does Tigger like? or Eeyore?);

- decoding the mangled spelling attempts in Christopher Robin's hand-written messages, and the sign on Owl's door;

... this is probably just the beginning, and the verse patterns that occur in Pooh's songs, and in the poems in Milne's two other Christopher Robin books, **When We Were Young**, and **Now We Are Six**, also deserve mathematical exploration.

But beware of the Walt Disney version of "Winnie-the-Pooh", which distorts Shepard's great illustrations (which were based directly on the actual toys of the original Christopher Robin, Milne's son, and the landscape near the Milne's country house), and has the bare-faced cheek to introduce spurious non-English characters such as GOPHER, and even a GIRL! (Harrumph!)

However it is interesting, and mathematically challenging, to explore the "sequel" recently created by David Benedictus **Return to the Hundred Acre Wood**, which is a deeply respectful homage to Milne, and Shepard, even though it introduces a new animal character, Lotte the Otter (almost borrowed from Kenneth Grahame's **Wind in the Willows**), and recounts several adventures when Christopher Robin comes home

in the long summer school holidays.

May Gibbs – *Snugglepot and Cuddlepie*: also *Scotty in Gumnut Land*, and *Prince Dande-Lion*

May Gibbs, like Norman Lindsay, is one of Australia's great early author-illustrators. The epic adventures of two gumnut babies, Snugglepot and Cuddlepie, and their struggles against the Big Bad Banksia Men, and their quest to see a human (only in the distance, timid Cuddlepie says, hopefully), are something that all Australian children should experience. (Similarly, try **Ruth Park *The Muddle-headed Wombat***, and **Dorothy Wall *Blinky Bill***.)

Mathematics?

- scale and relative size: gumnut babies are about 4 centimetres tall, at maturity, and Banksia Men are as big as actual Banksia cones: but does this actually fit with the size of adult kookaburras, frogs, goannas, snakes, beetles and ants and other bush animals, or the many varieties of fish that feature in the underwater adventures of the last sections of the book? (Does it matter if Gibbs chooses to combine tiny human-like gumnut creatures alongside full-size kangaroos, possums, and so on?)

- throughout *Prince Dande-Lion* (a rainy-day story that is told by Bill Bandicoot the gardener to young Bill and Bub, who live with Mrs Bear, and also appear in a book of their own, *Bill and Bub*) the names and vocabulary reflects the way the narrator has a head full of flower and botanical names (May Gibbs was herself a very keen gardener): the reader is challenged to grasp the intended pun-based meanings of expressions such as, "the King rhodedendron and the Queen rode a peony", and being careful in thick forest in case of a lurking agapanthus);

- the squiggly writing of messages on gumleaves, that looks like the chewed wriggling paths of grubs under tree-bark: and the way the gumnut community imitates many everyday activities of humans, but always with a bush-related twist.

Martin Waddell – *Once There Were Giants*
This is a seemingly simple, but beautifully illustrated story in which a little girl grows up and becomes a mother.
— The sheer succession of years and seasons, as children in a family grow up, and adults age, demands that a reader pay attention to natural passing of time, and events within a year and within a person's life, and within a family.
— Mathematics potential:
--Time – estimating actual ages: reading the clocks in the pictures: identifying times of day:
-- Measurement: estimating the sizes of children and adults:
-- Analysis: make a family tree.

Philippe Dupasquier — an author-illustrator with great mathematics potential!
Dupasquier is the illustrator of ***The Great Green Mouse Disaster***, a wordless picture-story book that is written (if a wordless story can, indeed, be "written") by Martin Waddell.

Dupasquier uses the whole-page illustrations to show the storeys and rooms of a large apartment block where many separate and interrelated plot threads are simultaneously unfolding, including the aftermath when a cage of green-coloured mice, intended to be delivered to a laboratory, is accidentally opened and the green mice run riot: the story, or the tapestry of stories, only exist IF the reader works very hard (using mathematical visual analysis and logical reasoning) to follow successive stages of connected events, and knock-on cause-and-effect interactions between separate threads of plot.

One of Dupasquier's own wordless picture-story books — *The Great Escape* — shows (visually "tells") what happens when a prisoner escapes from gaol and flees the warders and police. The book virtually invites readers to make a sketch-map of the town the prisoner flees through. The last pages contain actual picture-puzzles and spot-the-difference challenges. Dupasquier is an author-artist who plays with his readers (viewers), and with the very nature of what a "book" is, or can be.

As the author-illustrator of a collection of time-themed picture-story books about a day in a busy place, including *The Factory*, and *The Airport*, and *The Garage*, Dupasquier also forces the reader to work very hard mathematically, to see what happens, with successive pictures at different times of the day, at an airport, or in a factory. As people come and go through the pages, like successive moves in a board game, what one person does leads, logically, to what another person does. For example, at the airport, the wrapper of a snack-bar that is dropped by the person who eats the bar is later swept up by a roving sweeper-cleaner. Each double-page spread in these fascinating books is like a photo taken from the same position. But as the day passes, in each picture different people are present and different things occur.

Many other Dupasquier books involve solving visual puzzles, or understanding passing seasons in *The House on the Hill*, or making sense of the simultaneous story-telling that connects a father who is travelling overseas a long way away, and his child on the other side of the Earth.

Lucy Sprague Mitchell — *A Year in the City*
This classic, old (1948) **Little Golden Book**, by Lucy Sprague Mitchell, illustrated by Tibor Gergely (a Hungarian immigrant artist who worked for a while in the Disney Studios, and designed the backgrounds for *Snow White and the Seven Dwarves*, and illustrated other great Little Golden Books), presents the seasons in detail.
A little girl, Jenny, lives in a top-storey apartment, while her friend Peter lives in a ground-floor apartment next door. Together they can look out over the city panoramas, seeing distant trains, aeroplanes, harbours and skyscrapers, or they can look closer and learn how a building starts with an excavation, or workmen dig a hole in the streetto connect cables and pipes — the arteries of city life.
From Spring, with flowers in blossom, and fresh paint on railings, through the heat of Summer and children playing under sprinklers and in the park, to Autumn with the falling leaves and the fresh supplies of coal, and children buying new clothes (they grew out of old ones) to start school, and eventually Winter, with early snow and the arrival of Christmas — this book is a rich exploration of seasons, passing time, growth and building, and the diverse human life of a bustling city.
— it is full of pictures that show what is described in the text: a reader can explore the pictures in the same kind of way that we search for the image of Wally in *Where's*

Wally books
— some of the pictures show a high point of view, looking out and downwards across an urban landscape: the result is an oblique view that almost works as a picture map.

Mick Inkpen — *Kipper*
The child-like dog, Kipper, features in several titles, some of which have considerable mathematical potential. In ***Kipper's Birthday***, the ambiguity of a Birthday Invitation that says, "Come to my birthday tomorrow", which is accidentally posted ON the day of the actual birthday, leads to the natural and paradoxical question, "When is tomorrow?" - in the immortal words of the Paul Williams' song in the great children's gangster-spoof film *Bugsy Malone*, "Tomorrow never comes". Fortunately Kipper and his animal friends are happy to come for a deferred birthday party on the following day, so maybe tomorrow does come, after all.

Judi & Ron Barrett — *Cloudy with a Chance of Meatballs*
The topic of Chance (also known as Probability) is obvious in the title of this book, although, as with Emily Rodda's ***Pigs Might Fly***, the chanciness of weather occurs in a far-fetched fantasy-type setting, where meatballs might rain down from the sky. Or, as in Rodda's book, the meteorological conditions might be the extreme of unlikeliness or improbability known as a"grunter", or, officially an Unlikely Events Factor (UEF) storm of Force 8 — the kind of wacky-weather day when pigs just start floating through the air, and by a unanimous vote Parliament "passed a law that every citizen over the age of ten years had to wear a bag of fish and chips on his or her head in public at all times" (chapter 4, p 41).
On the other hand, weather is genuinely chancy (in real-life fish have occasionally fallen from the sky!). Even though the idea of cooked food falling from the skies is an amusing tall story, it can be used to introduce the real-world topic of droughts and floods, and the realistic probabilities of weather events.
Note that the tall-tale story in the original book version is rather different from the mad-scientist adaptation in the film version of *Cloudy With a Chance of Meatballs*. It is rarely safe to equate the story of a film version with the original book.

Notes from the Sixth Class

***The Gruffalo* by Julia Donaldson [also *The Gruffalo's Child*]**
A mouse tricks a number of animals that he is having lunch with a Gruffalo that eats the animals that the mouse meets. The Gruffalo is only a made up character to the mouse, but the Gruffalo turns out to be a real animal. The mouse then tricks the Gruffalo into thinking all the animals are scared of the mouse and the Gruffalo flees.
Mathematical thinking?
The mathematical thinking needed to understand story of ***The Gruffalo*** is INTUITIVE, INFORMAL, SPONTANEOUS AND INCIDENTAL, MENTAL
— Who is in the story, what are they like, and how do you know? Identify, classify and sort characters.
— Verse patterns: line length (short/long, pairs, rhythm, rhymes.
NOTE: we usually regard **RHYME** as part of the Literacy curriculum: but wherever patterns exist we use mathematical thinking to recognise and analyse them: in the case of rhymes, the patterns are in the visual sequence of letters and/or in the aural sequence of spoken sounds in the rhyming words — when two words rhyme, they have matching time-sequence aural-patterns that are equivalent to matching patterns of beads along a string. Similar comments apply to the analysis and classification of patterns of STRESS and/or numbers of SYLLABLES in lines of verse.
— Analysis of character features: as the mouse successively describes the supposedly imaginary fierce Gruffalo, it is as though the mouse is presenting pieces of a jigsaw puzzle: when the Gruffalo actually appears the reader sees all the pieces fitted together, in the way a paleontologist assembles the fossil bones of a new dinosaur.
— Time: narrative sequence: first the mouse meets a sequence of hungry characters, and outsmarts them: then the mouse meets the actual Gruffalo: and then the initial sequence is reversed.
— Size, relative size, and comparison: also comparison of relative strength.
— Classifying the literary genre: the mouse, who looks ordinary, small, and vulnerable, is a "Trickster" — a genre type who, like Homer's cunning Greek hero Odysseus (who invented the famous Wooden Horse that destroyed Troy), or Joel Chandler Harris' Black African folk-hero, Brer Rabbit, can think fast, or lie and cheat, to get out of trouble, or to defeat a bigger stronger opponent. Other classic Tricksters include Pippi Longstocking, Mary Poppins, Anansi the Spider, Loki the Norse demi-god.
NOTE: There is an official web-site: http://www.gruffalo.com, with information about Gruffalo films, and plays, and TV cartoons.
Also, the Wikipedia entry on the Gruffalo explains that Julia Donaldson (a playwrite) based the story on a traditional Chinese folk tale of a fox that borrows the terror of a tiger. Donaldson was unable to think of rhymes for "tiger", and so invented one for "know" instead:
> *Silly old fox [or, owl, or snake], doesn't he know?*
> *there's no such thing as a gruffalo!*

***The Tower to the Sun* by Colin Thompson**
The richest man on earth is talking to his grandson: all Earth's resources have been used up: pollution hides the sun: the man wants to see the sun before he dies: he tries using a balloon but this fails: then he decides to build a machine to collect all the buildings in the world and use these like building blocks to build a giant tower that will reaches above the pollution so he can see the sun: when this succeeds, all the

people on Earth are given one chance to go up to the top of the viewing platform above the pollution.

This is a strange story, with echoes of Dr Seuss's famous environmental cautionary verse tale *The Lorax*, or his even earlier prose story *Bartholomew Cubbins and the Ooblek*, in which an environmental/climate disaster happens when a king and his magicians try to meddle with the weather.

But as the illustrator, Thompson (an Australian author and illustrator) does a very clever, and mathematically interesting thing: his images are based on actual art and architecture. The buildings that are used to build the giant tower include famous buildings such as the Leaning Tower of Pisa, and the Eiffel Tower, and the Parthenon. One of his images of the tower being built is a pictorial homage (or borrowing — or "appropriation", the technical art-theory term that means "stealing") to Pieter Bruegel or Bruegel's famous oil painting of the Tower of Babel (this Tower is an early story in the Old Testament: a legend of the origins of the diversity of human languages — in the early days after the Expulsion from Eden, all humans spoke the same language, but when they were attempting to build a tower that would reach up to God's heaven, God stopped them by forcing them to begin speaking different, mutually unintelligible languages: C.S. Lewis uses this same curse of Babel in the conclusion of the last book in his adult "Space" trilogy, *That Hideous Strength*: Luis Borges also uses it in his striking short story about the Library of Babel, an idea which is also based on the legend of an infinity of monkeys typing on an infinity of typewriters for an infinite time, and, eventually, typing out Shakespeare's *Hamlet* — the challenge, in the legend, and in Borge's Library of Babel, is to find the unique typed version of *Hamlet* amongst the infinite number of incorrectly typed versions!)

Mathematical thinking?
— architectural and related construction;
— geometry; shapes, architecture (history, locations — including timelines, maps and a globe to locate the period and place of the famous buildings.

There may be no explicit demand for mathematical thinking; but there are clear opportunities for mathematical thinking. Many of Colin Thompson's books have this special visual characteristic that the large-scale images are built up, like a collage-homage, from small images that are otherwise unrelated to the large image.

***Greetings From Sandy Beach* — Bob Graham (1990)**
This story is about one family's camping holiday at the beach - a beach they must share with a bus load of school kids and The Disciples of Death motorbike gang!
Mathematical thinking
Beach features: suggest a sketch-map
Time ideas: summer, holiday period, travel time, day/night
Characters: individuals, families, groups and connections between them
Cause-effect: something happens as a result of something – logically connected events
Analysis: initial appearance (dangerous bikies?) to thoughtful understanding (friendly hairy gentlemen)

NOTE: a similar story of a beach holiday is **Roland Harvey *At the Beach*** (Allen & Unwin 2004). This is very carefully, and cleverly (!), illustrated so that the close-up images can always be located within the large picture-map-like panoramas, and the actual map:

— a detailed formal map is provided for Crabby Spit, the caravan park, camping ground, shops, and beaches;
— a detailed time-line can be made of the events during the days spent at the beach.

NOTE: several more of Roland Harvey's books include explicit SPATIAL THINKING demands detailed attention to scale, maps, point of view and orientation and location: for example *In the Bush* (about a family holiday at Wombat Flat), and *In the City* (about a family holiday visit to a city), and *To the Top End* (a family trip to the North of Australia — the end-papers map is effectively "upside-down"!) and *My Place in Space*. The Amazon.com displays for these Roland Harvey books include sample pages with the sketch maps, and full-page illustrations that show items that can be located on the maps.

Crusher is Coming — Bob Graham
Mathematical thinking?
— Analysis: initial appearances may be deceptive: experience leads to thoughtful understanding: the possibly big tough hero-worshipped "Crusher" may be a big softie at heart, who prefers to play with the baby sister when he visit his hero-worshipper.
— Can you draw a sketch plan of the house that Crusher visits?

Little Miss Tiny — Roger Hargraves
Little Miss Tiny is extremely small. She lives in a mouse hole, in a farm house: she does not have her own home. She climbs around the house, gets stuck in a piggy bank, is found by a cat and chased. Fortunately Mr Strong comes to the farm and rescues her. Mr Strong takes her to meet other people every week. She meets Mr Small and they become friends.
Mathematical thinking?
— Size matters! Size and relative size, scale, point of view from "small" eyes
— Also relative sizes and scale feature in:
   -- the series of chapter books by John Peterson, starting with *The Littles*, about a family of tiny humans who have some particular mouse features, such as a tail, mouse ears and sharp teeth.
   -- E.B. White's classic *Stuart Little*
   -- Mary Norton's great sequence starting with *The Borrowers* (five or six novels)
   -- Swift's first two voyages of Lemuel Gulliver, in *Gulliver's Travels*, the first to Lilliput, where Gulliver is a giant, and then to Brobdingnag, where he is a human among giants
   -- C.S. Lewis's *The Silver Chair*, where the Narnian Marshwiggle Puddleglum (based on Lewis's own gardener!), and the two Earth children Eustace and Jill, journey to the Harfang, a land of giants.

Aladdin
The classic Arabian story about the magical genie from the lamp and a magic carpet, who finds a treasure and saves a princess (this is one of the classic Arabian fairy stories in *A Thousand and One Nights*, a collection of stories — full of Arab culture, and very different in many ways from the European culture implicit in the fairytales of the Brothers Grimm, Perrault and others.)

NOTE: For many school students, the story of Aladdin is most familiar in the Walt Disney Studio feature animation. But there can be problems with Disney Studio art.

Disney-illustrated and Disney-retold versions of traditional tales may be popular but may not be the best to use in classrooms.
- the retelling may not be close enough to the originals, and often the Disney approach adds humour and emotional sentimentality that distorts the original; and
- the art style is consistently Disney-Studio, comic-book, and usually lacks the special qualities of the great children's illustrators such as Arthur Rackham, Heath Robinson and Charles Robinson, Ernest Shepard, Mary Shepard (Ernest's daughter, and illustrator of *Mary Poppins*), Pauline Baynes (illustrator of *"The Chronicles of Narnia"*), J. Lockwood Kipling (illustrator of Rudyard Kipling's *The Jungle Book*) and many others.

However, some Disney animations (and non-cartoon films) are close to the originals, visually and in narrative, or are themselves original: *The Lady and the Tramp*, *Dumbo*, or, where the animators themselves came from a traditional European background, *Bambi*, *Snow White and the Seven Dwarves*, and *Pinocchio*.

Frog and Toad — Arnold Lobel,
and other books featuring the two amphibian friends.
Several of the "Frog and Toad" stories (chapters) in these extended picture-story books have explicit mathematical demands:
— on one occasion Toad loses one of his jacket button and has paroxysms when Frog and friends bring him buttons they have found that do not have the same (mathematically) distinguishing features as his lost button (but there is a happy ending);
— on another occasion Toad makes a list of everything he will do in the next day, so that he can cross off each things as he does it: tis causes problems when the list blows out of his hands, and he had not written "Chase the list" in his list, so he feels powerless to chase the list. (Happily, Frog is at hand to help resolve Toad's dilemma.)

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Finally, consider also the mathematical demands and opportunities presented in:
- Herge's wonderful "*Tintin*" books, as the heroic reporter and explorer travels to exotic places around the world, and even to the Moon;
- Goscinny and Uderzzo's "*Asterisk*" books, set during the early years of the Roman conquering of Gaul (most of it — there is one small village that resists the conquering Romans …), with occasional travels to Britain and to Rome, and beyond;
- Peyo's magical "*Smurfs*": where it is not "X" that stands for something but the word "smurf", if you smurf what I mean.
- Carl Bark's "*Uncle Scrooge*" and "*Donald Duck*" comic-book stories: these classic, sometimes epic, adventures are currently being reissued in hardcover format.

As popular examples of picture-story books for older readers, using comic-book format, these are just the tip of the comic-book iceberg. Just be careful that the comics you work with in class avoid the offensiveness, violence, horror, or other negative aspects of many of the comic books on sale in newsagencies.