Classifying things
ONE MORNING, IN THE LIBRARY.

WHY DO YOU LOOK SO PUZZLED, SWEETY?

I'M DOING A PROJECT ON ANIMALS.

AND I'M MAKING A CATEGORIES CRUNCH MAP. BUT SOMETHING'S NOT RIGHT.
I think I see the problem. You're grouping animals according to colour.

What's wrong with that?
Good thinkers use categories to group similar types of things together.

- Colour is a useful feature if you want to draw a picture.
- But it doesn't help you to group similar types of animals together.
- Apart from colour, elephants and mosquitoes don't have much in common.
- So, to classify things, you put similar things together.
GOOD THINKERS USE RULES TO CREATE CATEGORIES CRUNCH MAPS.

YOU GOT IT! JUST FOLLOW A FEW RULES...

RULE 1: YOU MUST USE THE SAME PRINCIPLE TO CREATE EACH GROUP. (YOU CHOSE COLOUR.)

RULE 2: THE PRINCIPLE MUST BE FUNDAMENTAL.

FUNDAAAAA-WHAT? I'M LOST.
Good thinkers look for fundamental features that explain the nature of things.

Colour doesn’t tell you about an animal’s nature.

Colour is not a fundamental feature of animals.

Colour doesn’t tell you how an animal acts, or what it eats or anything important.

Cars can be green, but you wouldn’t put one in your “green” category.

So a fundamental feature is one that tells you something special about a thing’s nature.
GOOD THINKERS CHOOSE CATEGORIES OR GROUPS THAT DO NOT OVERLAP.

**Rule 3:** Groups should not overlap.

In a good classification, you should not be able to put the same thing into two different groups.

Birds can be any color, so can many other animals.

In a better classification, snakes and birds and bears would each have their own groups.
Good categories crunch maps help us to learn about the similarities and differences between things.

**Girl:** Why is it so important to separate categories like that?

**Teacher:** 'Cos similar things have similar features. When we group them together, it's easier to learn about them.

**Girl:** What we learn about cobras will probably help us learn about other snakes too.
SO, TO RECAP...
RULE 1: USE THE SAME PRINCIPLE TO CREATE ALL GROUPS.

RULE 2: USE A FUNDAMENTAL PRINCIPLE.

RULE 3: DON'T LET GROUPS OVERLAP!

AND DON'T FORGET A GROUP THAT ALL THE OTHER GROUPS CAN BELONG TO.

SO RULE 4 IS TO MAKE SURE THERE IS A BIG GROUP FOR ALL THE SMALLER GROUPS.
Those are all the rules. And you can keep using them to make more and more specific categories crunch maps.

You mean like a whole categories crunch map for birds? Cool!
Concept Mapping
ONE DAY, AT A CAR SHOW, TOM DECIDES HE WANTS TO DESIGN HIS VERY OWN SPORTS CAR.

DO YOU MIND IF I TAKE ONE OF THESE?
Later, in front of the drawing board.

Tom starts building a concept map to capture what he knows about cars.

He begins by writing a focus question.

What do I know about cars?
WHAT DO I KNOW ABOUT CARS?

Wheels  Windows  Bumpers  Shock Absorbers  Brakes
Fuel  Electricity  Pollution  Bonnet  Gearbox
Oil  Transport  Mags  Lights  Traffic Jams
Hub Caps  Steering Wheel  Dashboard  Carpets  Clutch
Accidents  Seats  Doors  Engine  Radiator

Then he writes down everything that comes to mind when he thinks about cars.
Next, he groups together ideas that are related to each other.

**WHAT DO I KNOW ABOUT CARS?**

- Steering wheel
- Windows
- Bumpers
- Shock absorbers
- Fuel
- Electricity
- Axle
- Bonnet
- Pollution
- Transport
- Mags
- Brakes
- Hub caps
- Wheels
- Dashboard
- Engine
- Accidents
- Seats
- Gearbox
- Body shell
- Oil
- Radiator
- Doors
- Traffic jams
- Carpets
- Speed
Next, Tom creates headings that describe each group of objects and ideas.

- Fuel
- Electricity
- Axle
- Bonnet
- Bumpers
- Shock absorbers
- Clutch
- Body shell
- Engine
- Traffic jams
- Pollution
- Hub caps
- Accident

- Things related to cars
- Trim
- Things the engine needs
- Mechanical parts
- Body work
Next, Tom thinks of linking words that link cars to the ideas and objects he has written on the board.

Fuel, Electricity, Bumpers, Shock absorbers, Axle, Bonnet, Clutch, Body shell, Engine, Traffic jams.

Have include produces can cause provided shows can be controls such as.
THEN, ON A NEW PAGE, OR A CLEAN BOARD, TOM STARTS BUILDING HIS CONCEPT MAP.

CARS

TRANSPORT  ACCIDENTS  TRAFFIC JAMS  TRIM

MECHANICAL PARTS

HE PUTS THE MOST GENERAL IDEAS AT THE TOP OF THE MAP.
Then he continues to build the map by filling in all the ideas and objects he wrote down.

He also fills in the linking words that he identified to link the objects and ideas on his map.
IN THE END, HE HAS A CONCEPT MAP THAT HELPS HIM TO THINK OF A NEW DESIGN FOR A CAR.

That settles it. I'm building an electric car.
Defining things
IN ENGLISH CLASS, TIA ASKED JOJO TO DEFINE SOMETHING THAT HE ENJOYS.

OK, THEN HOW ABOUT THIS? "GAMES ARE FUN ACTIVITIES".

I'M SUPPOSED TO WRITE A DEFINITION FOR GAMES, BUT I CAN'T USE A DICTIONARY.

THAT'S A BIT VAGUE, DON'T YOU THINK?

DICTIONARIES ARE A GOOD PLACE TO START, BUT THEY'RE NOT PERFECT.

SOMETIMES THEY JUST GIVE SIMILAR WORDS.

RULE 1: DEFINITIONS SHOULD NOT BE UNCLEAR OR VAGUE.

AND THEY DON'T USUALLY DESCRIBE THE CONTEXT THAT YOU NEED TO UNDERSTAND THEM.

OK, WHAT ABOUT, "GAMES ARE AMUSING ACTIVITIES"?

OH, BOY. THIS COULD TAKE A WHILE.
Rule 2: Definitions should not be flowery or metaphorical.

How about, "A game is like a play wherein actors perform"?

Rule 3: Definitions should avoid negative terms unless absolutely necessary.

Ok then, Shakespeare, "A game is not work".

Now you're onto something! But you should avoid negative terms.

To make a good definition, think of things that are similar to what you are trying to define.

To help yourself out, think about this: What other activities are "not work"?

Besides games there are hobbies, travel, dancing...

Stop! You can't use the word, "like", in a definition. No similes or metaphors!
Right! Games, hobbies, travel, dancing are all forms of recreation.

That’s it! “A game is a form of recreation”.

So I still have to work out what makes games special forms of recreation?

Exactly... what things make games different from hobbies, travel, dancing, singing, playing music?

Rule 4: A definition needs two parts like your name. One part is like your surname. It tells you about the family of the thing you’re defining. One part is like your first name. It tells you what is special or different about the thing.

Hold it! Games are just part of the recreation family.
To begin making a good definition, just say in plain words what is involved.

But it's obvious what sets games apart from things like dancing or listening to music. Games have rules!

The rules tell you what your goals are. They tell you how to win. And they tell you what you can and can't do.

Wow, Jo! I think that's a brilliant definition.

Yeah! A game is a form of recreation made up of rules describing a goal and how to achieve it. Great!

You really think so?
Once you have a working definition, you should check if it is too broad.

Before we settle on the definition, we just need to test it.

Test it?! How do you test words?

Like, is it too broad? That is, does it include things that aren’t games?

Like what?!

Like jogging, or singing, or playing music. They all have certain rules.

OK, I suppose they do.

But you can still do those things without following rules. So the rules don’t make them what they are.
Always check if your definition is too narrow.

Are we done yet?

No, Speedy. The definition doesn’t seem to be broad, but we must still ask if it’s too narrow.

You mean, have we missed anything?

Yeah. Does the definition cover cricket, baseball, Monopoly?

I reckon it’s perfect for all of those!

But what about something like throwing a ball against a wall?

There aren’t really rules for that, but I suppose it is a game. Damn!

Don’t worry, Jo. It’s not much of a game, is it? It’s a borderline case.
BORDER—WHAT? WHATEVER IT IS, IT SOUNDS LIKE WE'RE ALMOST DONE!

WHEN YOU DEFINE THINGS, THERE WILL ALWAYS BE BORDERLINE CASES.

THIS GYM TOWEL HAS A BLUE STRIPE AND A GREEN STRIPE. A DEFINITION OF THE COLOURS SHOULD DISTINGUISH BETWEEN THE TWO.

BUT THIS BLUE-GREEN STRIPE IS ON THE BORDER BETWEEN THE TWO COLOURS. WE SHOULDN'T THROW OUT A DEFINITION BECAUSE OF BORDERLINE CASES.

SO, AS LONG AS A DEFINITION IS NOT TOO BROAD AND NOT TOO NARROW, IT SHOULD BE OK?

EVEN IF THERE ARE SOME BORDERLINE CASES THAT COULD GO EITHER WAY!

THINK OF GOLDILOCKS: NOT TOO BROAD, NOT TOO NARROW, BUT JUST RIGHT!
Generating New Ideas
GREAT THINKERS ASK QUESTIONS TO HELP THEM THINK OF NEW IDEAS.

YOU THINK WE CAN TURN THIS PIECE OF JUNK INTO SOMETHING COOL?

IF WE ASK THE SCRAMBLE QUESTIONS, WE'LL THINK OF PLENTY WAYS TO MAKE IT AWESOME!

SCRAMBLE STANDS FOR SUBSTITUTE, COMBINE, REARRANGE, ADAPT, MODIFY, BREAK A RULE, LEAVE OUT, EXAGGERATE.
GREAT THINKERS ASK, "WHAT CAN I SUBSTITUTE?"

WE SUBSTITUTED A CHAIR FOR THE SITTING PLANK, WHICH IS MUCH MORE COMFORTABLE!
Great thinkers ask, "What can I combine?"

SCRAMBLE

We combined an electric motor with the kart to make it faster.
GREAT THINKERS ASK, "WHAT CAN I COMBINE?"

WE COMBINED AN ELECTRIC MOTOR WITH THE KART TO MAKE IT FASTER.
Great thinkers ask, "What can I rearrange?"

We rearranged the wheels so that the bigger ones were at the back.
GREAT THINKERS ASK, "WHAT CAN I MODIFY?"

WE MODIFIED THE BRAKES TO MAKE THEM EASIER TO CONTROL.
Great thinkers ask, "What rules can I break?"

We broke a rule by adding seatbelts and lights. 'Cos karts don't usually have those!
GREAT THINKERS ASK, "WHAT CAN I LEAVE OUT?"

WE LEFT OUT THE FOOT PLANK. IT'S REALLY NOT NECESSARY.
GREAT THINKERS ASK, "WHAT CAN I EXAGGERATE?"

WE EXAGGERATED THE WAY THE KART LOOKS BY GIVING IT A PAINT JOB.
Mind Mapping
ONE AFTERNOON, THE DAY BEFORE A TEST.

WHY DO YOU LOOK SO TIRED, JO?

ALEXANDER GRAHAM BELL. THAT'S WHY...

WE'VE BEEN READING BOOKS ABOUT HIM FOR HOURS. BUT WE CAN'T SEEM TO REMEMBER ANYTHING WE READ.

WHY DON'T YOU MAKE A MIND MAP?
Everything you need to know about Alexander Graham Bell on one page.

Wow!

How do you make one?

It's easy!
AND SO THE GIRLS EXPLAIN...

**STEP 1:** TURN YOUR PAGE HORIZONTAL AND WRITE YOUR MAIN IDEA IN THE MIDDLE. INSTEAD OF WRITING, THE GIRLS DREW A PICTURE OF BELL.

**STEP 2:** DRAW BRANCHES IN NEW COLOURS FOR EACH NEW MAIN IDEA. YOU DON'T HAVE TO COMPLETE ONE IDEA BEFORE GOING TO THE NEXT. FILL UP YOUR MAP AS YOU GO.

WHEN YOU READ ABOUT A NEW IDEA, WRITE SOMETHING ON THE MAP THAT WILL TRIGGER A MEMORY OF IT.

YOU WILL FIND A PLACE FOR MOST IDEAS ON A FEW MAIN BRANCHES.
Step 3: Add pictures or photos or drawings that help trigger memories about different ideas.

The branches aren't everything. Because you don't think only in words.

You think in pictures too. So fill your map with drawings. Or cut out photos and stick them on.

Anything that helps you think about your subject has a place on your mind map.
Step 4: Use arrows to link common ideas together. You can use different kinds and colours of arrows to show different things.

Thinking of one idea will always make you think of another. You can link these ideas on your mind map with arrows.

Thoughts, ideas and memories aren’t islands.
You can use link facts from different idea branches. Or you can show a particular path of thinking by connecting thoughts in a single branch.
AND DON'T FORGET THAT THE MORE SPECIFIC YOUR IDEAS BECOME, YOU SHOULD MAKE YOUR BRANCHES THINNER.
Before you know it, your map will be full.

Full of memory triggers that will help you to think about your subject.
GREAT STUFF! SO CAN WE COPY YOUR MAP?

MAKING THE MAP IS WHAT HELPS YOU TO THINK ABOUT YOUR SUBJECT, NOT COPYING!

YOU JUST DON'T GET IT, DO YOU?!
Reading appreciation
SOPHIE LOVES TO READ. JOJO FINDS IT BORING. BUT HE'S ABOUT TO LEARN HOW TO MAKE READING INTERESTING AND FUN.

WHY THE LONG FACE?
Good readers are people who enjoy reading.

I'm trying to read about Shaka Zulu's war tactics, but I can't seem to get any of this stuff into my head!

What questions are you asking?

And Sophie knows that being a good reader is about asking questions while you read.

Questions? I'm reading, Soph, not talking.

Jo, you have to ask yourself questions while you're reading.

Otherwise the words will just bounce around inside your head and you won't remember anything.
GOOD READERS ASK, "WHAT DO I ALREADY KNOW ABOUT WHAT I'M READING?"

HERE'S AN EXAMPLE...

WHILE YOU'RE READING, ASK YOURSELF, "WHAT DO I ALREADY KNOW ABOUT THIS TOPIC?"

THEN COMPARE WHAT YOU KNOW WITH WHAT YOU ARE READING.

WELL I ONCE SAW A TV SHOW ABOUT SHAKA'S BUFFALO HORN ATTACK FORMATION.

HIS FASTEST WARRIORS RAN AROUND THE ENEMY IN THE SHAPE OF A BUFFALO'S HORNS.
GOOD READERS ASK, "WHAT DOES THIS REMIND ME OF THAT I HAVE READ BEFORE?"

THAT'S GREAT!

YOU CAN ALSO ASK YOURSELF, "DOES THIS REMIND ME OF ANYTHING I'VE READ ABOUT BEFORE?"

COME TO THINK OF IT, THAT'S JUST THE WAY MY FAVOURITE FOOTBALL TEAM ATTACKS. I'VE READ THE TEAM BIOGRAPHY.
Good readers think of questions they can ask while they are reading.

You can also ask yourself what general questions you have about what you’re reading.

Well now I have loads of questions!

Firstly, if the fast runners were the horns, then where did other kinds of warriors go?
Good readers think of what it would be like to talk to the writer. They think of questions they might like to ask.

You can also ask yourself, "What would I like to ask the writer?"

I'd like to ask him if Shaka's war tactics affected modern football!
SO DOES THAT HELP YOU?

LIKE YOU WON'T BELIEVE, SOPH!

BECAUSE NOW I HAVE AN IDEA FOR MY HISTORIC PROJECT!
While I was reading, I kept asking myself how Shaka's attack formation compares with my favourite football team.
Scientific Method
A rubber bouncy ball breaks the window and goes flying around the classroom.

Good scientists begin with a question. They want to discover an answer to some mystery.

Wow! I wonder what makes it bounce like that?

Yeah! I wonder how many times a normal ball bounces?

Let's do an experiment!

Cool! First we need a focus question.

How many times does a ball bounce? And how high on each bounce?
GOOD SCIENTISTS MAKE PREDICTIONS BEFORE THEY EXPERIMENT.

I THINK IT BOUNCES MORE OFTEN IF IT'S HOLLOW.

I THINK A BALL BOUNCES THREE TIMES.

GOOD SCIENTISTS CHOOSE EQUIPMENT AND MATERIALS CAREFULLY.

WHAT DO WE NEED?

A RULER. A TAPE MEASURE. PAPER. AND A MARKER.

GOOD SCIENTISTS WORK OUT STEP-BY-STEP PROCEDURES TO FOLLOW, LIKE RECIPES FOR THEIR EXPERIMENTS.

HOW ARE WE GOING TO DO THIS?

DROP. CATCH AND MARK. OVER AND OVER 'TIL THERE'S NO MORE BOUNCE.

I THINK IT BOUNCES HIGHER IF IT'S MADE OF RUBBER.
Good scientists observe, measure, and record their measurements accurately.
Good scientists organise their data to make sense of it, and they back up their claims with evidence.

I claim that the height of each bounce is a constant fraction of the height from which it fell.

The material of the ball determines the bounce height and the number of times the ball bounces.

We know this because we tested three different kinds of balls and we observed similar results in each case.

Scientists use computers to make models of their results to understand them better.
Good scientists summarise their conclusions.

We learned that there is a law that governs the bounce of a ball.

Now we can make better predictions about the bounce of a ball because we know more about gravity.

Good scientists are skeptical about their conclusions.

How can we be sure we’re not fooling ourselves?

What were the weaknesses in our experiment?

Did we repeat the experiment enough times?
GOOD SCIENTISTS REFLECT ON THEIR EXPERIMENTS. THEY LOOK INWARD TO SEE IF THEY CAN IMPROVE THEIR THINKING.

WHAT WERE THE WEAKNESSES IN OUR OLD THINKING?

I WAS SURPRISED BY THE WAY DIFFERENT KINDS OF BALLS BOUNCED SO DIFFERENTLY.

HOW DID OUR PREDICTIONS COMPARE WITH OUR RESULTS?

THIS HAS RAISED NEW QUESTIONS SUCH AS HOW MANY TIMES WILL A BALL BOUNCE ON THE MOON?

AND THEY LOOK OUTWARD FOR CONNECTIONS BETWEEN THE RESULTS OF THEIR EXPERIMENTS AND OTHER AREAS OF KNOWLEDGE AND EXPERIENCE.

HOW DOES THIS RELATE TO GRAVITY?

IS THERE SOMETHING IN NATURE THAT DEPENDS ON THE LAW WE HAVE DISCOVERED?

HOW DOES IT RELATE TO A BALL THAT IS THROWN DOWN INSTEAD OF DROPPED?