

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.

ANIMALS

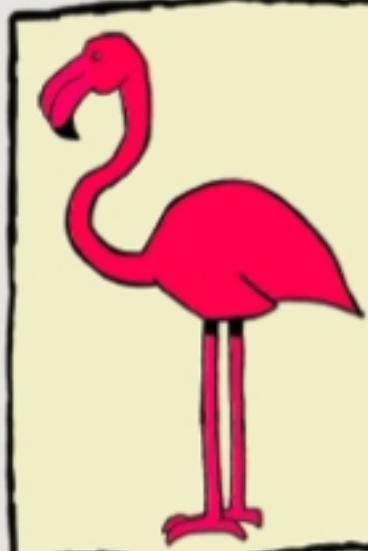
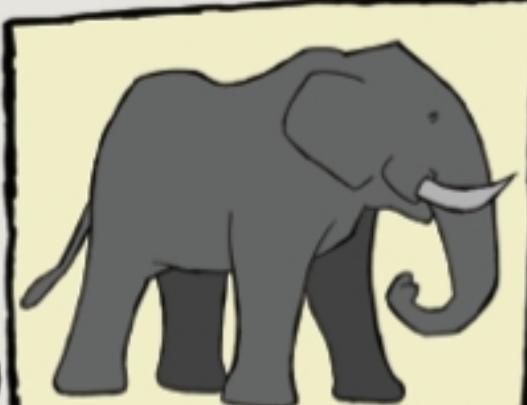


I THINK I
SEE THE PROBLEM.
YOU'RE **GROUPING**
ANIMALS ACCORDING
TO COLOUR.



WHAT'S
WRONG WITH
THAT?

GOOD THINKERS USE CATEGORIES
CRUNCH MAPS TO GROUP SIMILAR
TYPES OF THINGS TOGETHER.



BUT IT
DOESN'T HELP
YOU TO GROUP
SIMILAR TYPES
OF ANIMALS
TOGETHER.

APART
FROM COLOUR,
ELEPHANTS AND
MOSQUITOS 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.



FUNDA-
WHAT?! NOW
I'M LOST.



GOOD THINKERS LOOK FOR FUNDAMENTAL FEATURES THAT EXPLAIN THE NATURE OF THINGS.



COLOUR IS NOT A FUNDAMENTAL FEATURE OF ANIMALS.

COLOUR DOESN'T TELL YOU ABOUT AN ANIMAL'S **NATURE**.

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 COLOUR. 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.

WHY IS IT SO IMPORTANT TO SEPARATE CATEGORIES LIKE THAT?

'COS SIMILAR THINGS HAVE SIMILAR FEATURES. WHEN WE GROUP THEM TOGETHER, IT'S EASIER TO LEARN ABOUT THEM.

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.

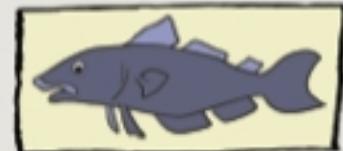
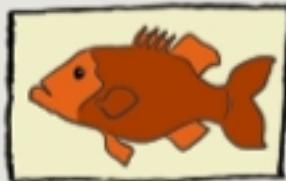
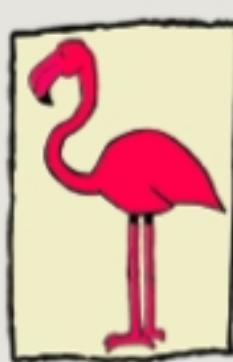
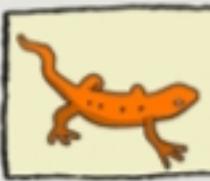
RULE 2: USE A FUNDAMENTAL PRINCIPLE.

RULE 3: DON'T LET GROUPS OVERLAP!

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

ANIMAL

SO RULE 4 IS TO MAKE SURE THERE IS A **BIG** GROUP FOR ALL THE **SMALLER** GROUPS.

FISH**MAMMALS****INSECTS****BIRDS****REPTILES****AMPHIBIAN**

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?

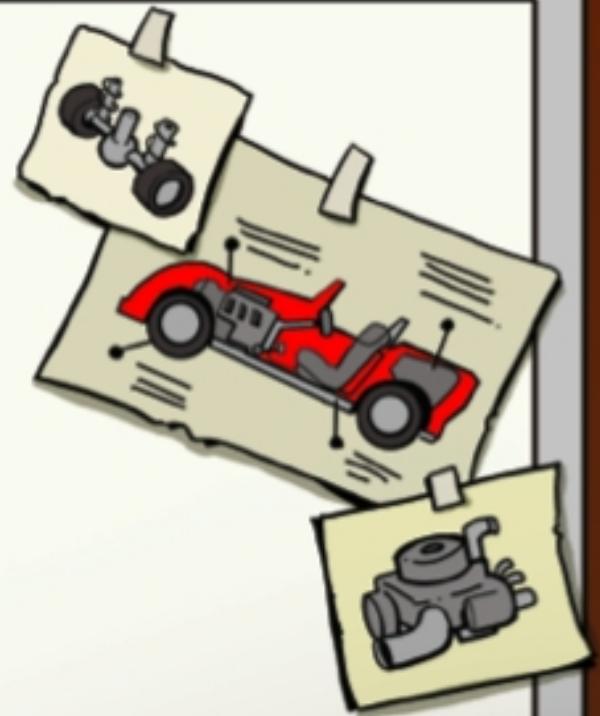


LATER, IN FRONT OF THE DRAWING BOARD.

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?



THEN HE WRITES DOWN EVERYTHING THAT COMES TO MIND WHEN HE THINKS 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	SPEED
HUB CAPS	STEERING WHEEL	DASHBOARD	CARPETS	CLUTCH	AXLE
ACCIDENTS	SEATS		DOORS	ENGINE	RADIATOR



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

CLUTCH

HUB CAPS

WHEELS

DASHBOARD

BODY SHELL

ACCIDENTS

SEATS

GEARBOX

ENGINE



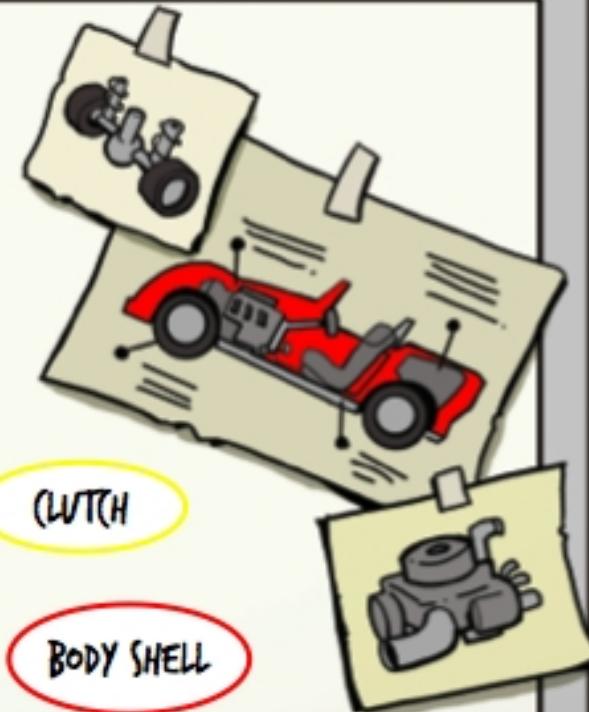
RADIATOR

DOORS

TRAFFIC JAMS

CARPETS

SPEED



NEXT, TOM CREATES HEADINGS THAT DESCRIBE EACH GROUP OF OBJECTS AND IDEAS.

BUMPERS

SHOCK ABSORBERS

FUEL

ELECTRICITY

AXLE

BONNET

POLLUTION

CLUTCH

HUB CAPS

BODY SHELL

ACCIDENTS

ENGINE



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.

BUMPERS

SHOCK ABSORBERS

FUEL

ELECTRICITY

AXLE

BONNET

POLLUTION

CLUTCH

HUB CAPS

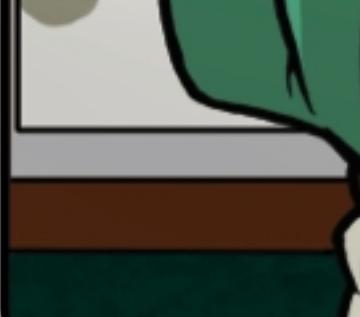
BODY SHELL

ACCIDENTS

ENGINE

HAVE
INCLUDE
PRODUCES
CAN CAUSE
PROVIDED
SHOWS
CAN BE
CONTROLS
SUCH AS

TRAFFIC JAMS



THEN, ON A NEW PAGE, OR A CLEAN BOARD,
TOM STARTS BUILDING HIS CONCEPT MAP.

CARS

TRANSPORT ACCIDENTS TRAFFIC JAMS

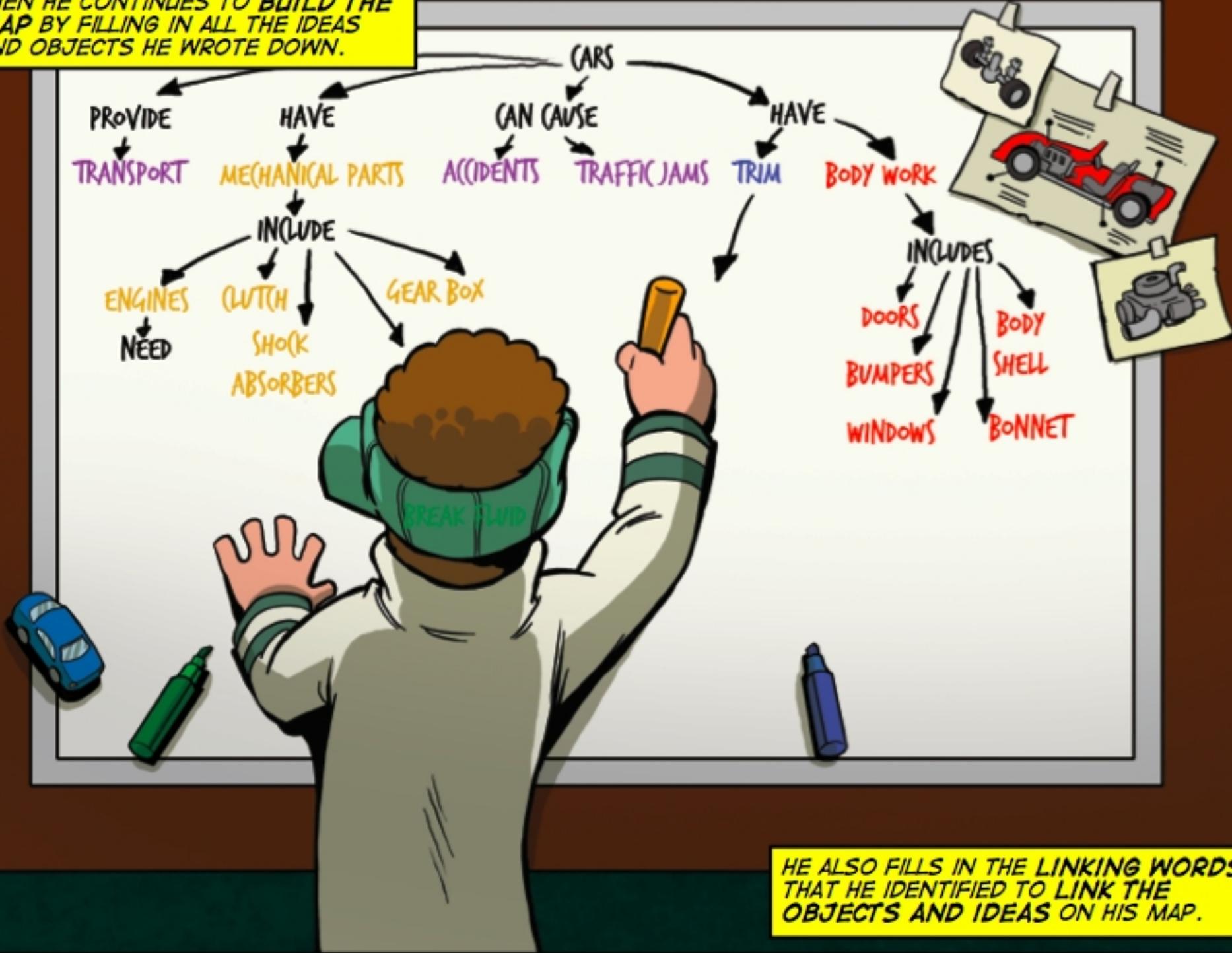
MECHANICAL
PARTS

TRIM

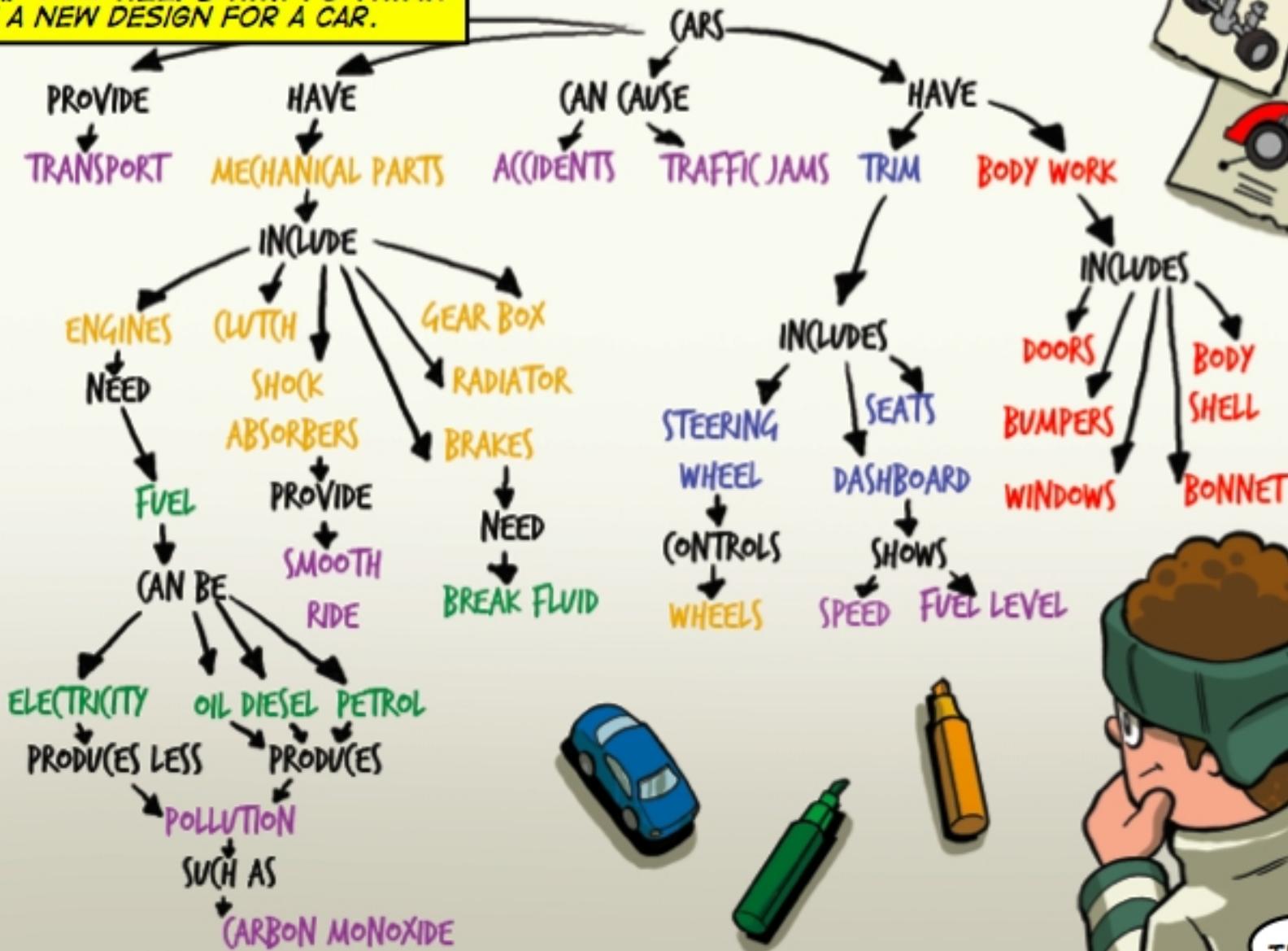


HE PUTS THE MOST GENERAL
IDEAS AT THE TOP OF THE MAP.

THEN HE CONTINUES TO BUILD THE MAP BY FILLING IN ALL THE IDEAS AND OBJECTS HE WROTE DOWN.



IN THE END, HE HAS A CONCEPT MAP THAT HELPS HIM TO THINK OF A NEW DESIGN FOR A CAR.



Defining things



IN ENGLISH CLASS, TIA ASKED JOJO TO DEFINE SOMETHING THAT HE ENJOYS.

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

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



SOMETIMES THEY JUST GIVE **SIMILAR WORDS**.

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

OK, THEN HOW ABOUT THIS?

"GAMES ARE **FUN** ACTIVITIES".

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

RULE 1:
DEFINITIONS SHOULD NOT BE UNCLEAR OR VAGUE.

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"?



STOP! YOU
CAN'T USE THE
WORD, "LIKE", IN A
DEFINITION. NO
**SIMILES OR
METAPHORS!**

**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...





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.



YOU REALLY
THINK SO?

YEAH! A GAME
IS A FORM OF
RECREATION MADE UP OF
RULES DESCRIBING A
GOAL AND HOW TO
ACHIEVE IT. GREAT!



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?

YOU ASK
QUESTIONS,
OF COURSE!

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 BROAD. BUT WE
MUST STILL ASK IF ITS
TOO NARROW.

YOU MEAN, HAVE WE
MISSED ANYTHING?



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.

SCRAMBLE

GREAT THINKERS ASK,
"WHAT CAN I
SUBSTITUTE?"

SCRAMBLE



WE SUBSTITUTE 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?"



SCRAMBLE

WE COMBINED AN
ELECTRIC MOTOR WITH THE
KART TO MAKE IT FASTER.



GREAT THINKERS ASK,
"WHAT CAN I
REARRANGE?"

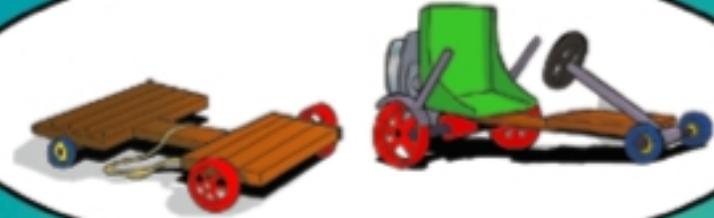
SCRAMBLE

WE REARRANGED THE
WHEELS SO THAT THE
BIGGER ONES WERE AT
THE BACK.



GREAT THINKERS ASK,
"WHAT CAN I MODIFY?"

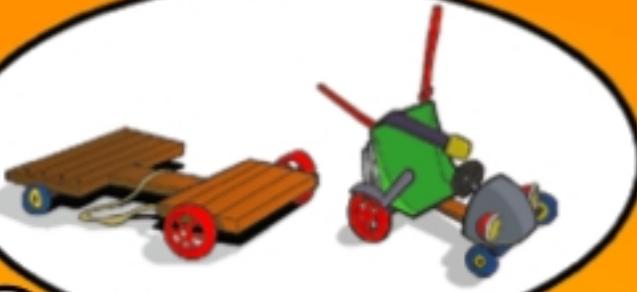
SCRAMBLE



WE MODIFIED
THE BRAKES TO
MAKE THEM EASIER
TO CONTROL



GREAT THINKERS ASK, "WHAT RULES CAN I BREAK?"



SCRAMBLE

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.



SCRAMBLE

GREAT THINKERS
ASK, "WHAT CAN I
EXAGGERATE?"



SCRAMBLE

Mind Mapping



ONE AFTERNOON, THE
DAY BEFORE A TEST.

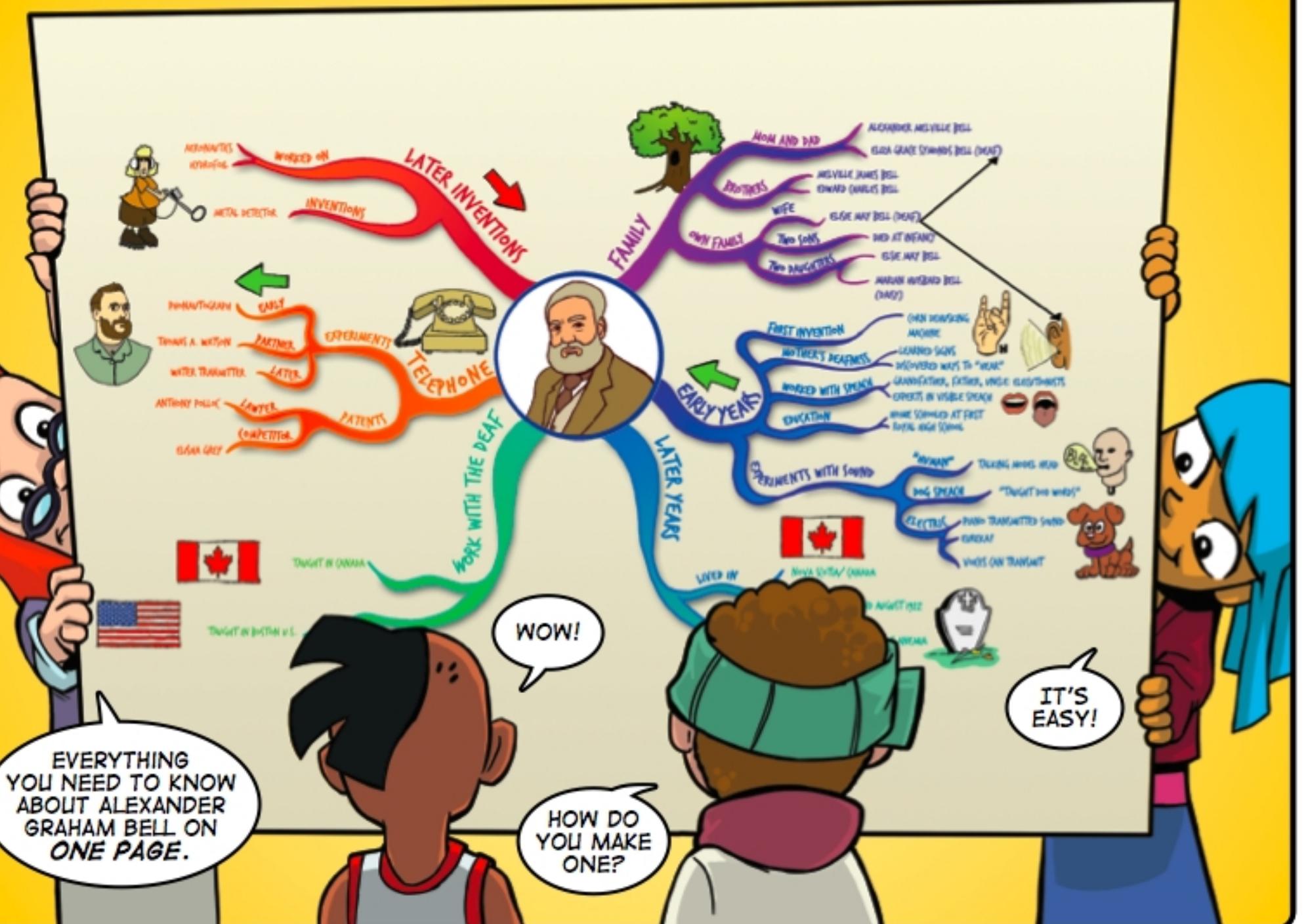
WHY DO YOU
LOOK SO
TIRED, JO?

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?





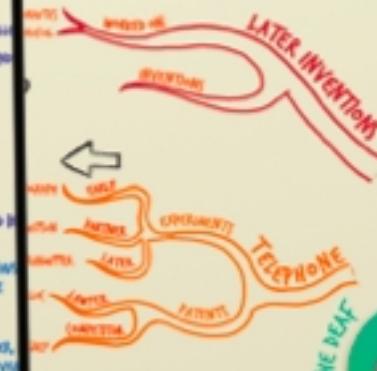
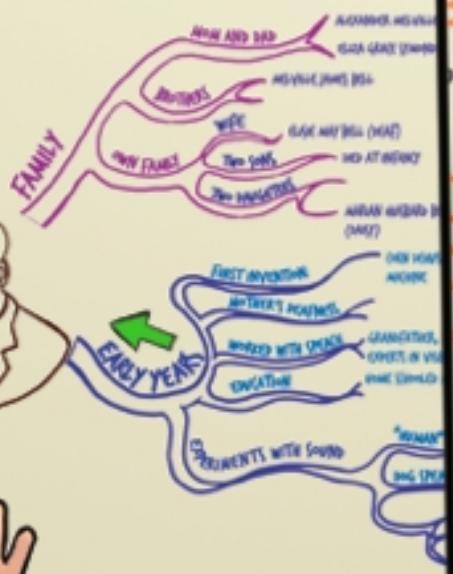
AND SO THE GIRLS EXPLAIN...

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

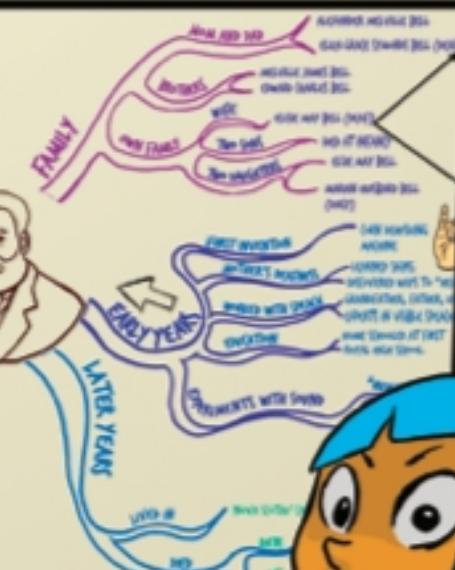
STEP 2: DRAW BRANCHES IN NEW COLOURS FOR EACH NEW MAIN IDEA. YOU DON'T HAVE TO COMPLETE ONE IDEA BEFORE GOING TO THE NEXT. FILL UP YOUR MAP AS YOU GO.



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.

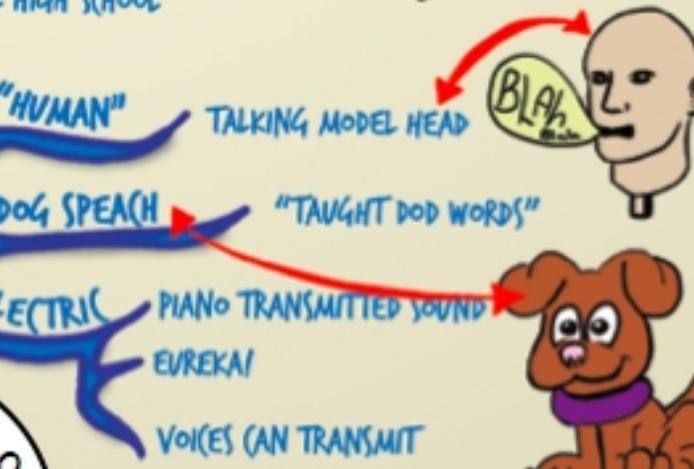


STEP 3: ADD PICTURES OR PHOTOS OR DRAWINGS THAT HELP TRIGGER MEMORIES ABOUT DIFFERENT IDEAS.



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.

FAMILY

MOM AND DAD

ROTHERS

MELVILLE JAMES BELL
EDWARD (CHARLES BELL)

WIFE

ELISIE MAY BELL (DEAF)

TWO SONS

DIED AT INFANCY

TWO DAUGHTERS

ELISIE MAY BELL

MARIAN WISBARD BELL
(DAISY)

FIRST INVENTION

CORN DEHUSKING
MACHINE

MOTHER'S DEAFNESS

LEARNED SIGN

DISCOVERED WAYS TO "HEAR"
GRANDFATHER, FATHER, UNCLE: ELECTUONISTS

WORKED WITH SPEECH

EXPERTS IN VISIBLE SPEECH

EDUCATION

HOME SCHOoled AT FIRST
ROYAL HIGH SCHOOL

EARLY YEARS

THOUGHTS, IDEAS
AND MEMORIES
AREN'T ISLANDS.

THINKING OF
ONE IDEA WILL
ALWAYS MAKE
YOU THINK OF
ANOTHER.

YOU CAN **LINK**
THESE IDEAS ON
YOUR MIND MAP
WITH **ARROWS**.



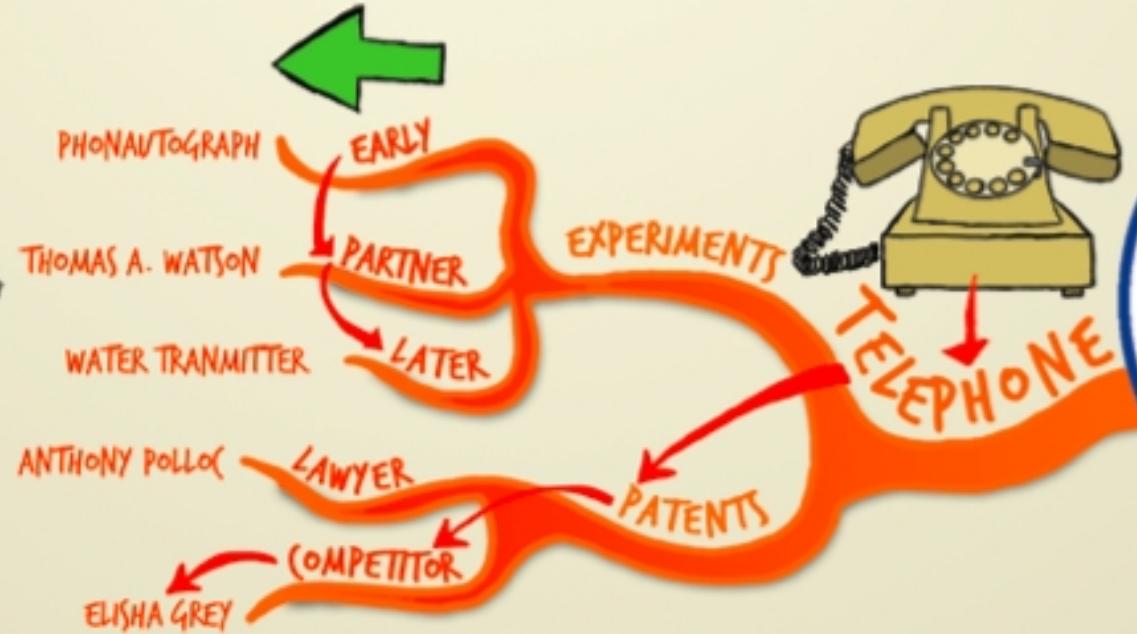
"HUMAN"

TALKING MODEL HEAD

TAUGHT DOG WORDS

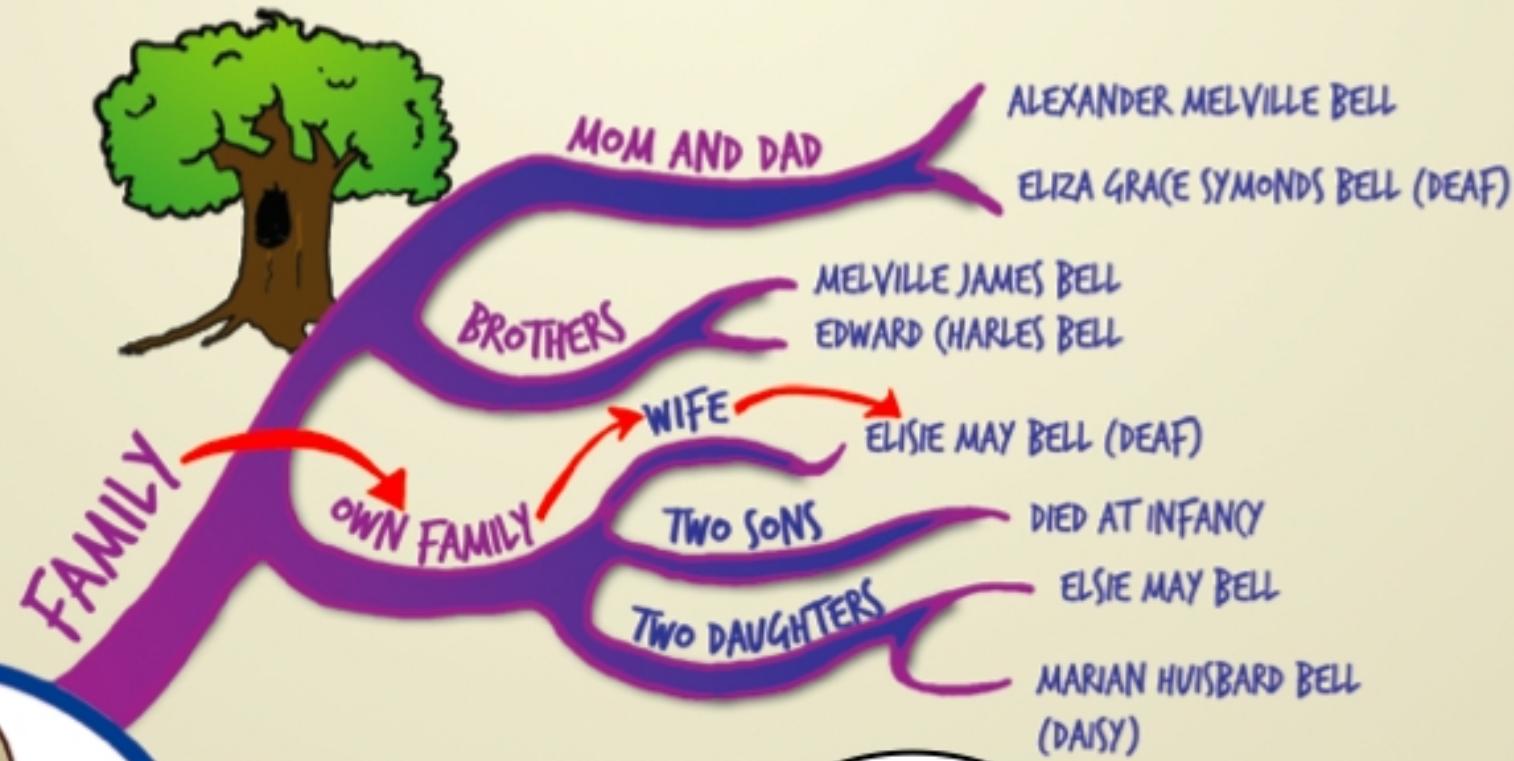
TRANSMITTED SOUND





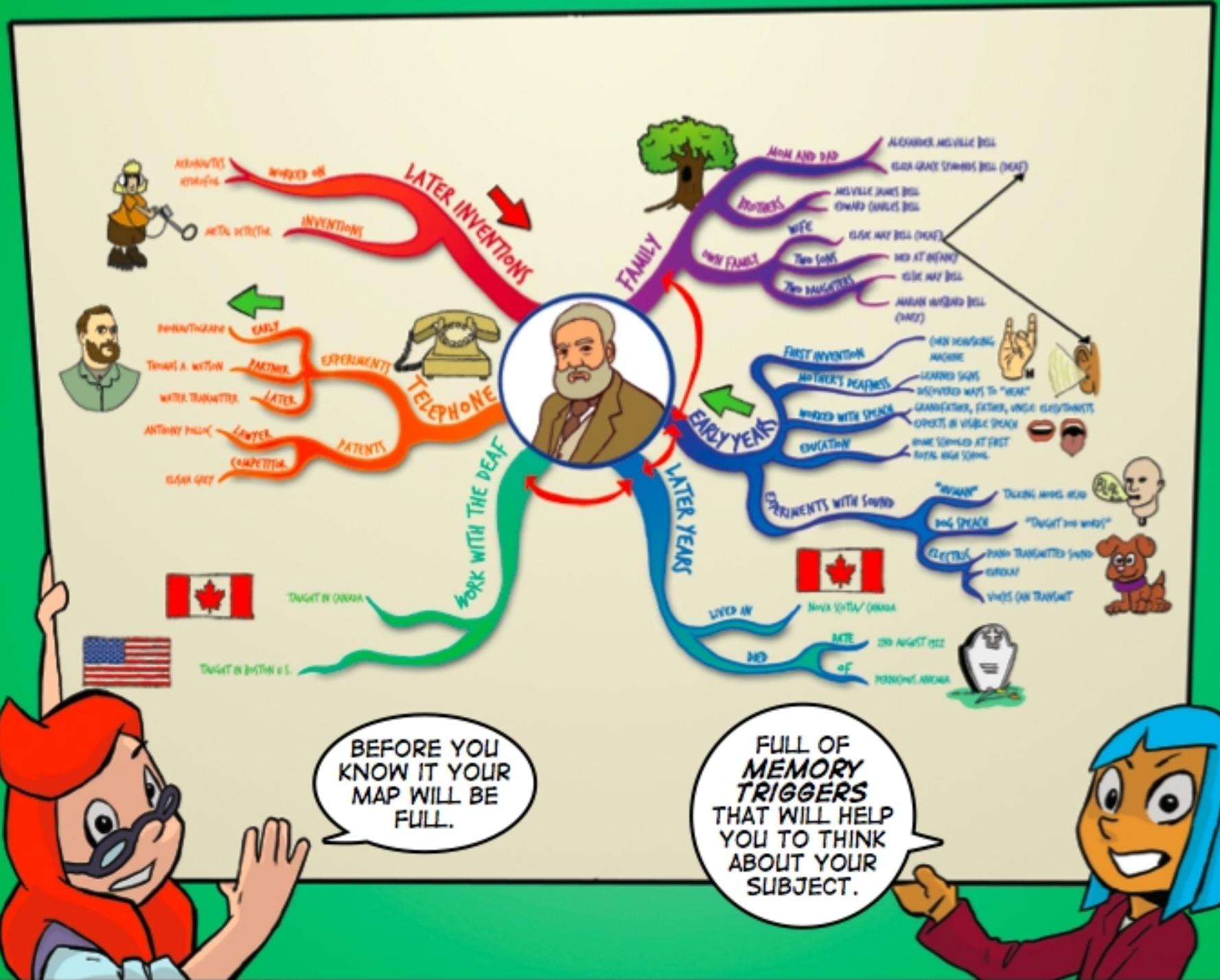
OR YOU CAN SHOW A
PARTICULAR PATH OF
THINKING BY
CONNECTING THOUGHTS IN
A SINGLE BRANCH.





AND DON'T
FORGET THAT THE
MORE **SPECIFIC**
YOUR **IDEAS**
BECOME, YOU
SHOULD MAKE YOUR
BRANCHES
THINNER.





YOU JUST
DON'T GET IT,
DO YOU?!

GREAT STUFF!
SO CAN WE **COPY**
YOUR MAP?

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

Reading appreciation



SOPHIE LOVES TO READ. JOJO FINDS IT
BORING. BUT HE'S ABOUT TO LEARN HOW TO
MAKE READING INTERESTING AND FUN.



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?"

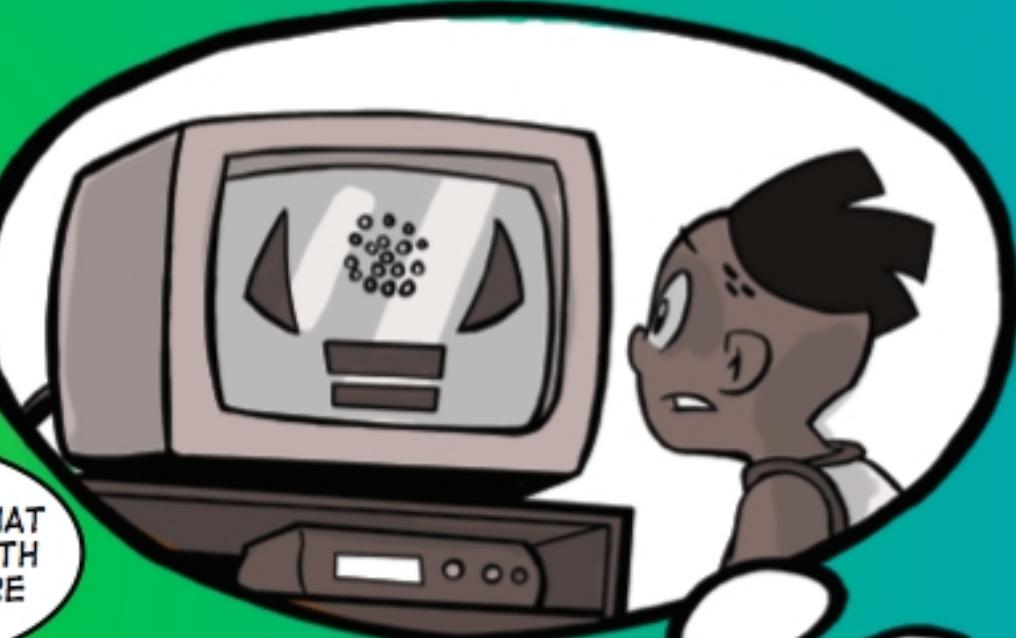
HERE'S AN EXAMPLE...

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 WARRIOR**S 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.



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?"



SO DOES THAT HELP YOU?

LIKE YOU WON'T BELIEVE, SOPH!

BECUSE NOW I HAVE AN IDEA FOR MY *HISTORY 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.

LET'S DO AN EXPERIMENT!



HOW MANY TIMES DOES A BALL BOUNCE?

AND HOW HIGH ON EACH BOUNCE?



GOOD SCIENTISTS MAKE PREDICTIONS BEFORE THEY EXPERIMENT.

I THINK A BALL BOUNCES THREE TIMES.



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



I THINK IT BOUNCES HIGHER IF IT'S PINK. JUST KIDDING.



I THINK IT BOUNCES HIGHER IF IT'S MADE OF RUBBER.



GOOD SCIENTISTS CHOOSE EQUIPMENT AND MATERIALS CAREFULLY.

WHAT DO WE NEED?



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



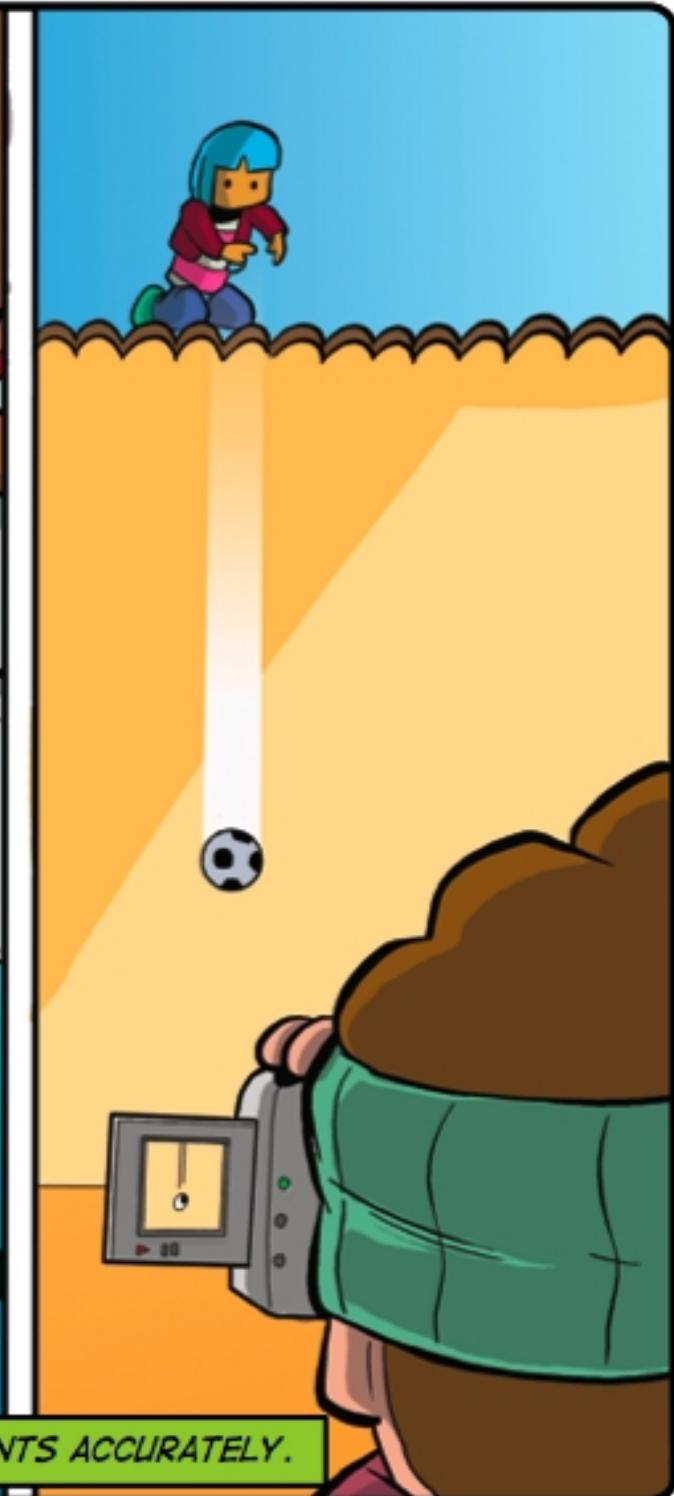
GOOD SCIENTISTS WORK OUT STEP-BY-STEP PROCEDURES TO FOLLOW. LIKE RECIPES FOR THEIR EXPERIMENTS.

HOW ARE WE GOING TO DO THIS?



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





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.

GOOD SCIENTISTS ARE SKEPTICAL
ABOUT 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**.



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?

HOW DID OUR PREDICTIONS COMPARE WITH OUR RESULTS?

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

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?



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