

Classifying things

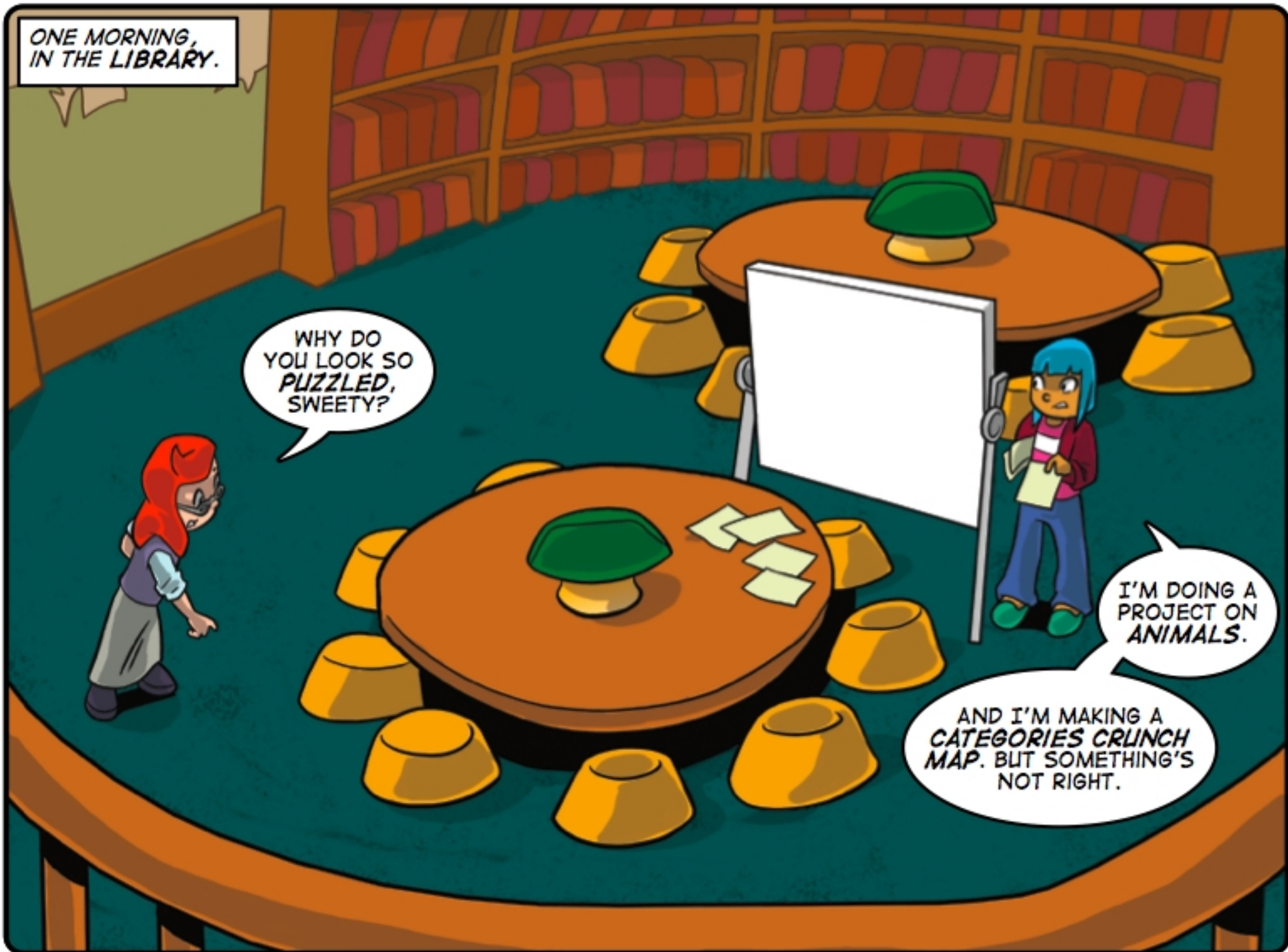


ONE MORNING,
IN THE LIBRARY.

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.



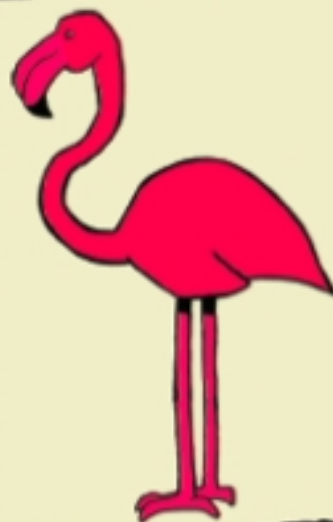
ANIMALS



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.



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
MOSQUITOS DON'T
HAVE MUCH IN
COMMON.

SO, TO
CLASSIFY
THINGS, YOU PUT
SIMILAR THINGS
TOGETHER.

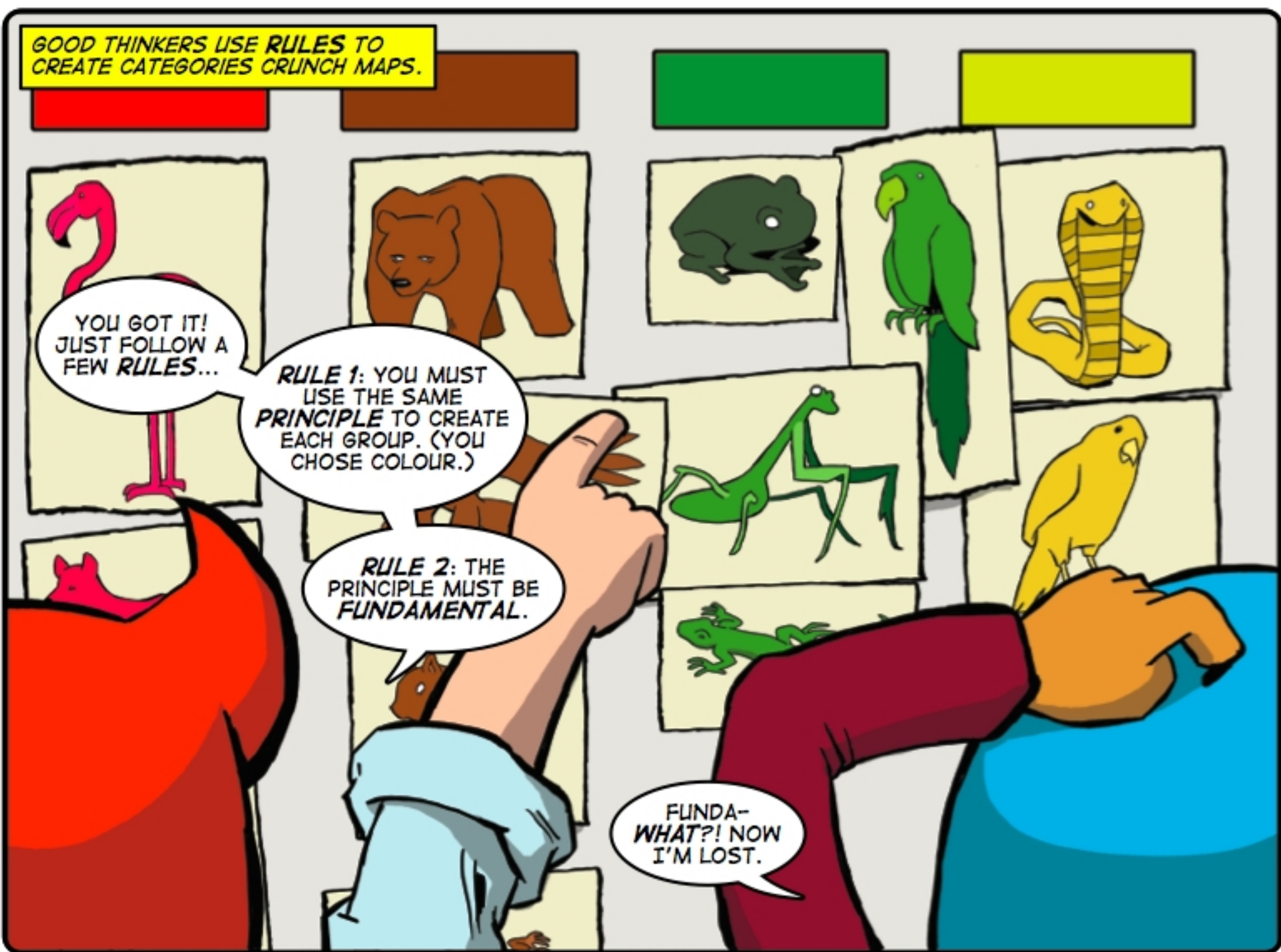
GOOD THINKERS USE **RULES** TO
CREATE CATEGORIES CRUNCH MAPS.

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.



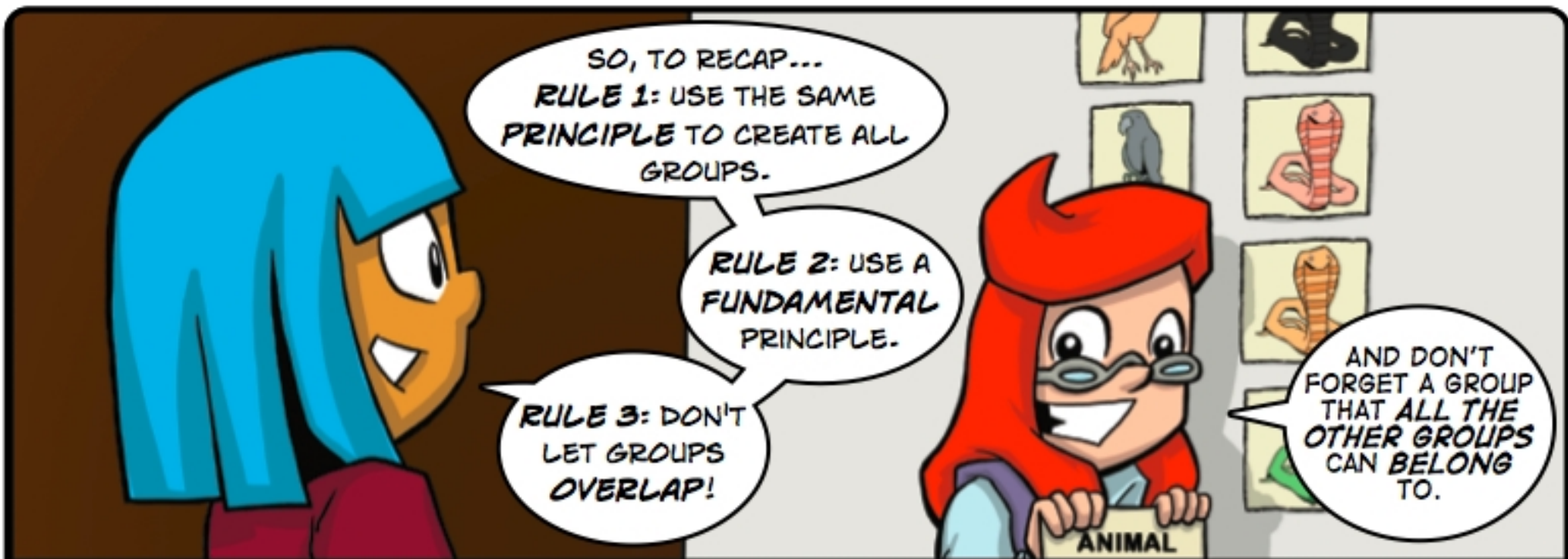
GOOD CATEGORIES CRUNCH MAPS HELP US TO LEARN ABOUT THE **SIMILARITIES AND DIFFERENCES** BETWEEN THINGS.

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.



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!

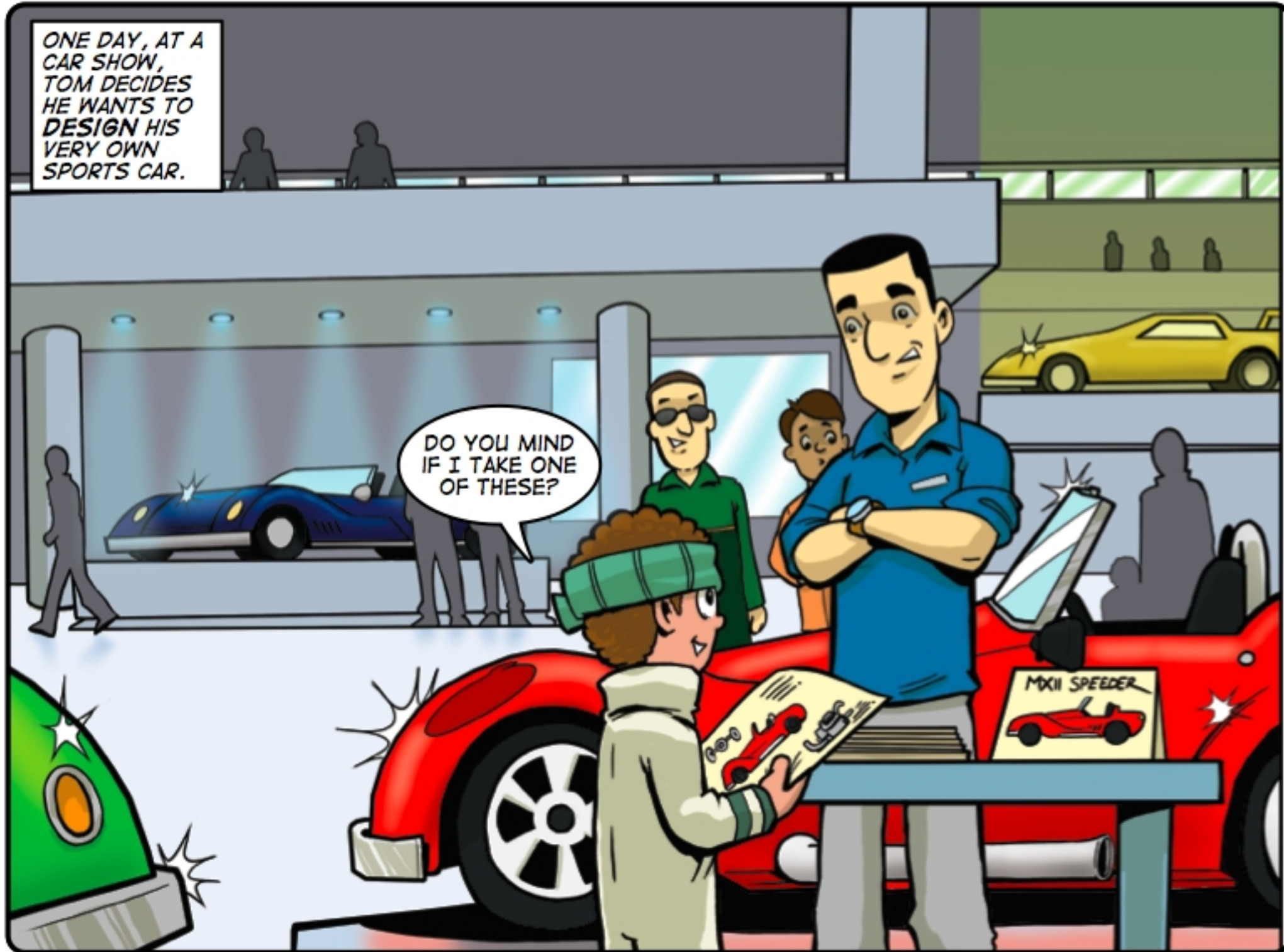


Concept Mapping



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

HUB CAPS

WHEELS

DASHBOARD

GEARBOX

ACCIDENTS

SEATS

RADIATOR

DOORS

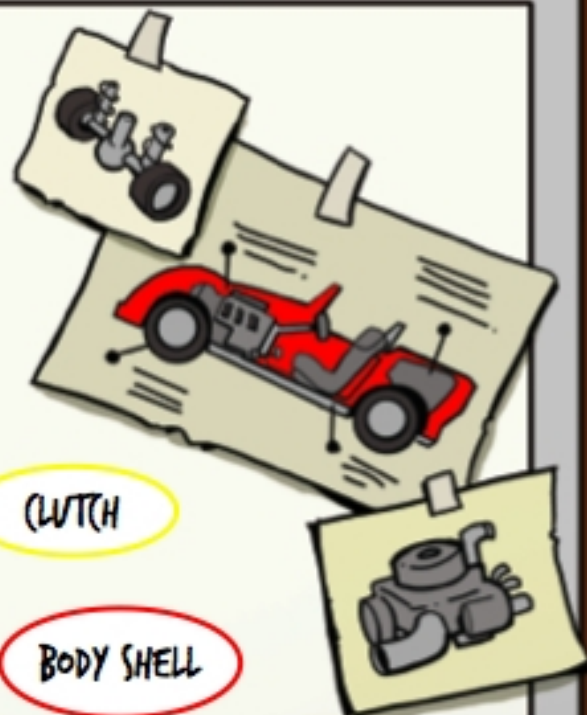
ENGINE

OIL

CARPETS

SPEED

TRAFFIC JAMS



CLUTCH

BODY SHELL



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

FUEL

ELECTRICITY

BUMPERS

SHOCK
ABSORBERS

AXLE

BONNET

CLUTCH

POLLUTION

HUB CAPS

ACCIDENTS

BODY SHELL

ENGINE

TRAFFIC JAMS

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

POLLUTION

HUB CAPS

ACCIDENTS

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

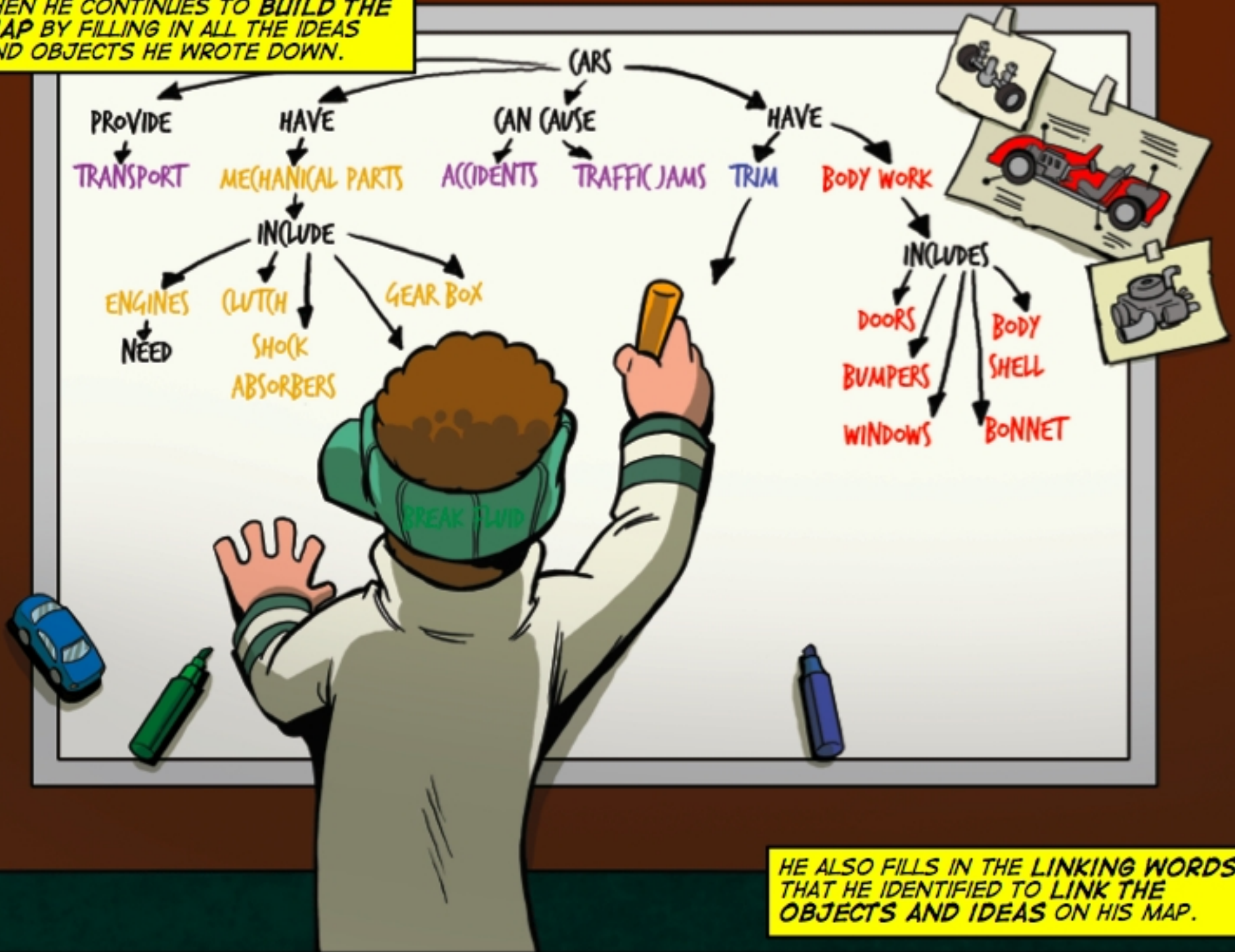
TRIM

MECHANICAL
PARTS



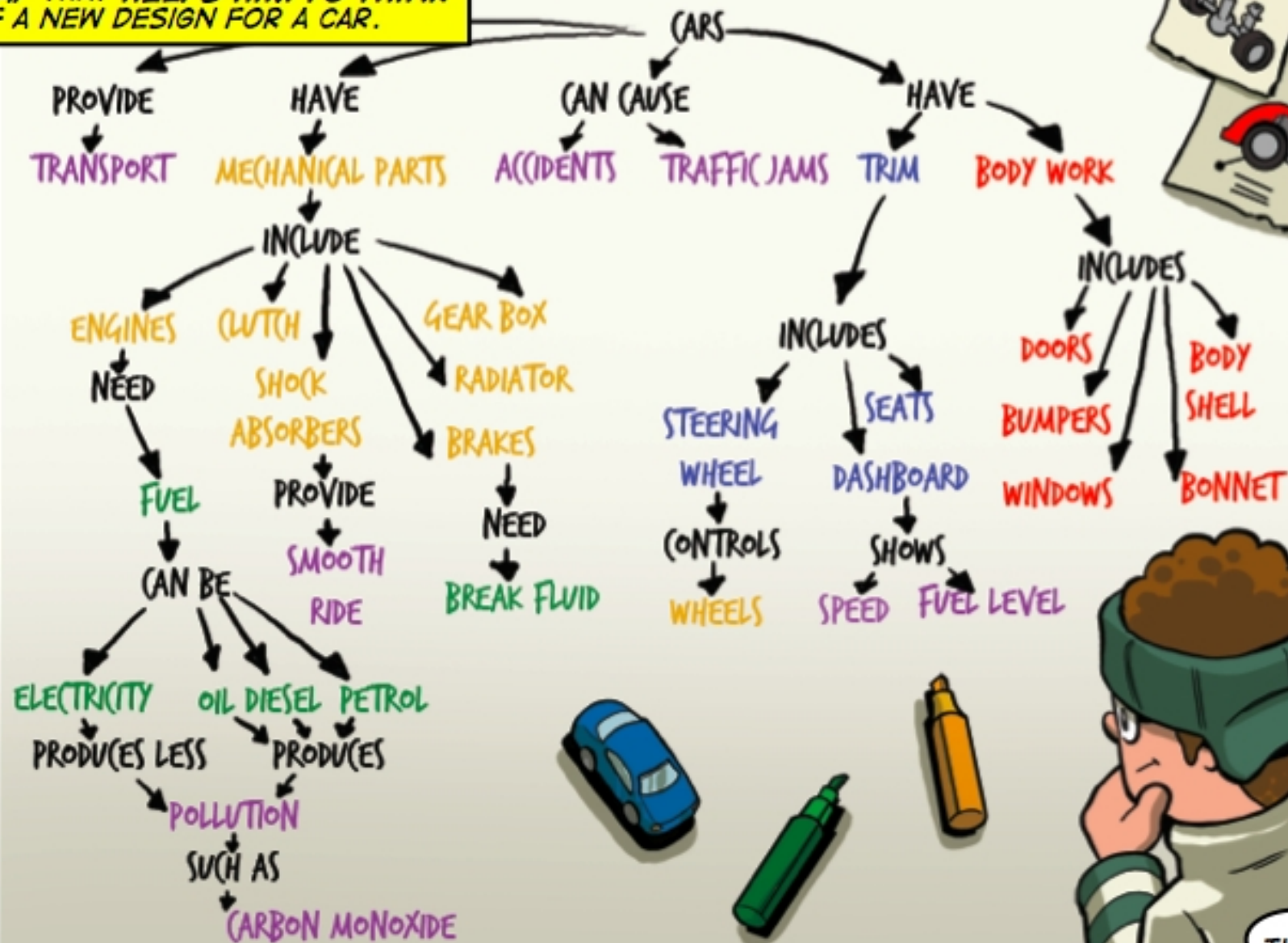
HE PUTS THE MOST GENERAL IDEAS AT THE TOP OF THE MAP.

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**.

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.

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?

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 TOO BROAD. BUT WE
MUST STILL ASK IF ITS
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.

SCRAMBLE

GREAT THINKERS ASK,
"WHAT CAN I
SUBSTITUTE?"

SCRAMBLE



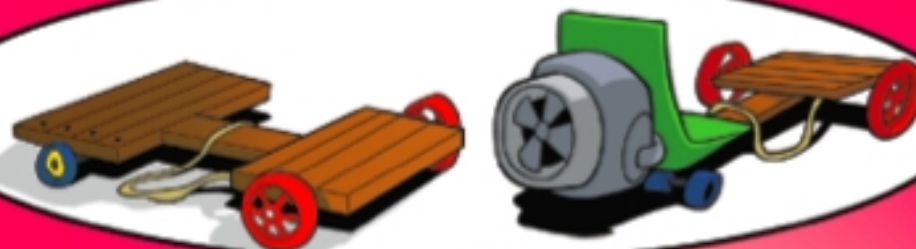
WE **SUBSTITUTED** A
CHAIR FOR THE SITTING
PLANK, WHICH IS MUCH
MORE **COMFORTABLE**!



GREAT THINKERS ASK,
"WHAT CAN I COMBINE?"

SCRAMBLE

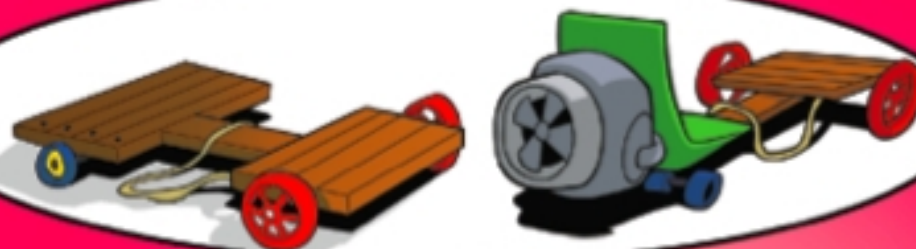
WE COMBINED AN
ELECTRIC *MOTOR* WITH THE
KART TO MAKE IT *FASTER*.



GREAT THINKERS ASK,
"WHAT CAN I COMBINE?"

SCRAMBLE

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



GREAT THINKERS ASK,
"WHAT CAN I
REARRANGE?"

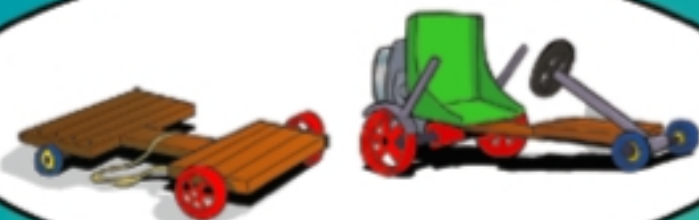
SCRAMBLE



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?"



WE *EXAGGERATED*
THE WAY THE KART
LOOKS BY GIVING IT A
PAINT JOB.

SCRAMBLE

Mind Mapping



ONE AFTERNOON, THE
DAY BEFORE A TEST.

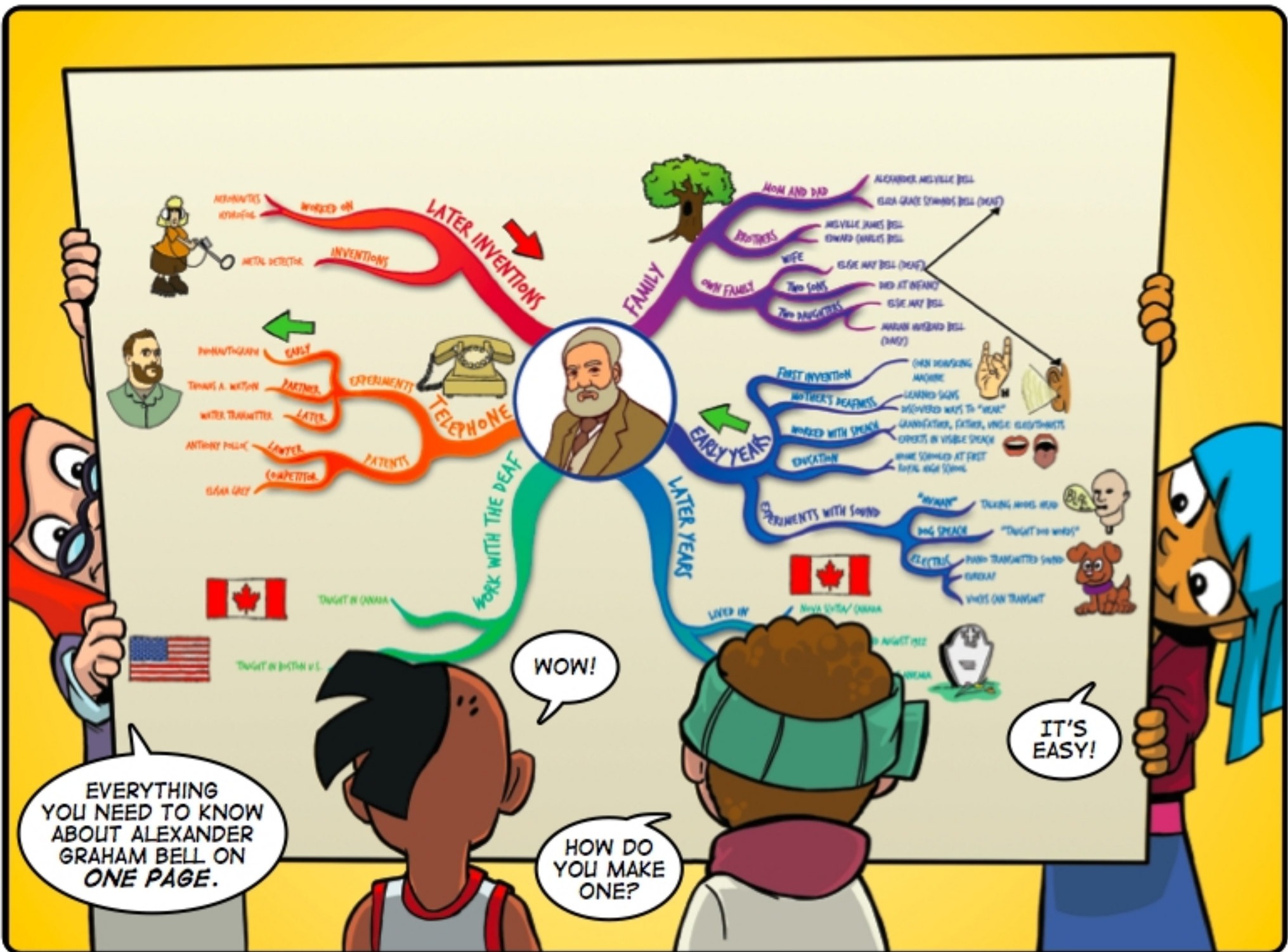
WHY DO YOU
LOOK SO
TIRED, JO?

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?



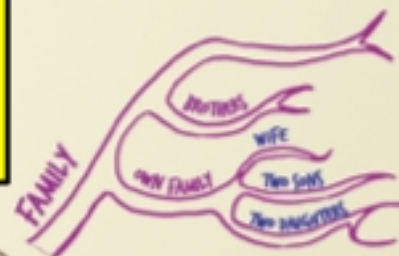


AND SO THE GIRLS EXPLAIN...

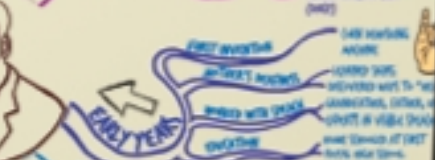
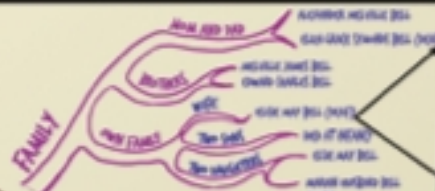
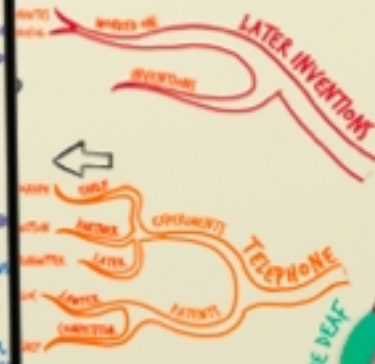
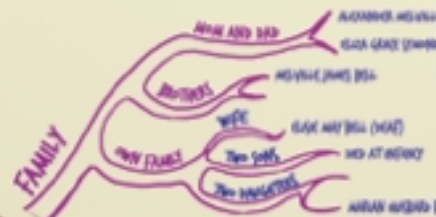
STEP 1: TURN YOUR PAGE HORIZONTAL AND WRITE YOUR MAIN IDEA IN THE MIDDLE. INSTEAD OF WRITING, THE GIRLS DREW A PICTURE OF BELL.



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.



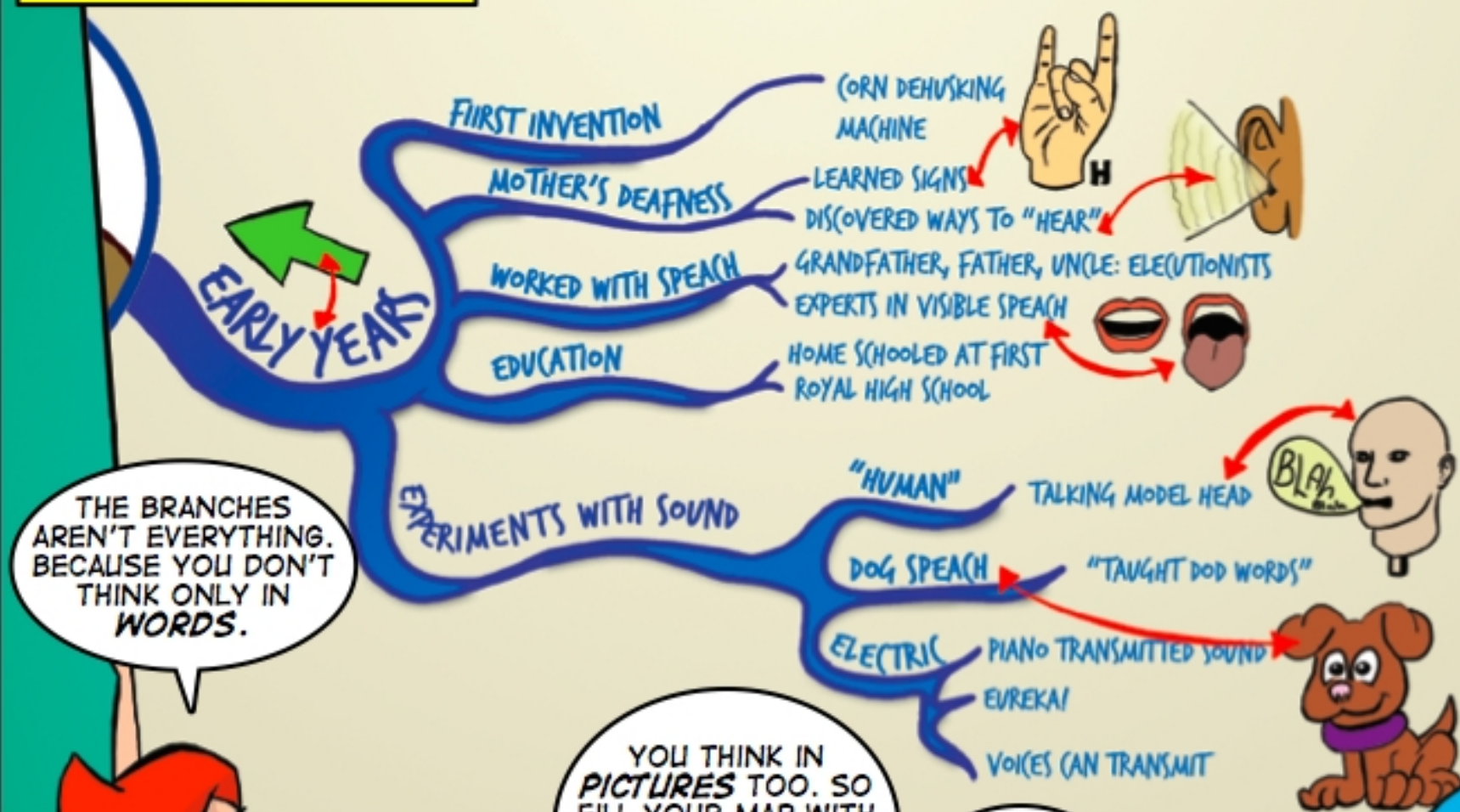
WHEN YOU READ ABOUT A NEW IDEA, WRITE SOMETHING ON THE MAP THAT WILL **TRIGGER** A MEMORY OF IT.



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.

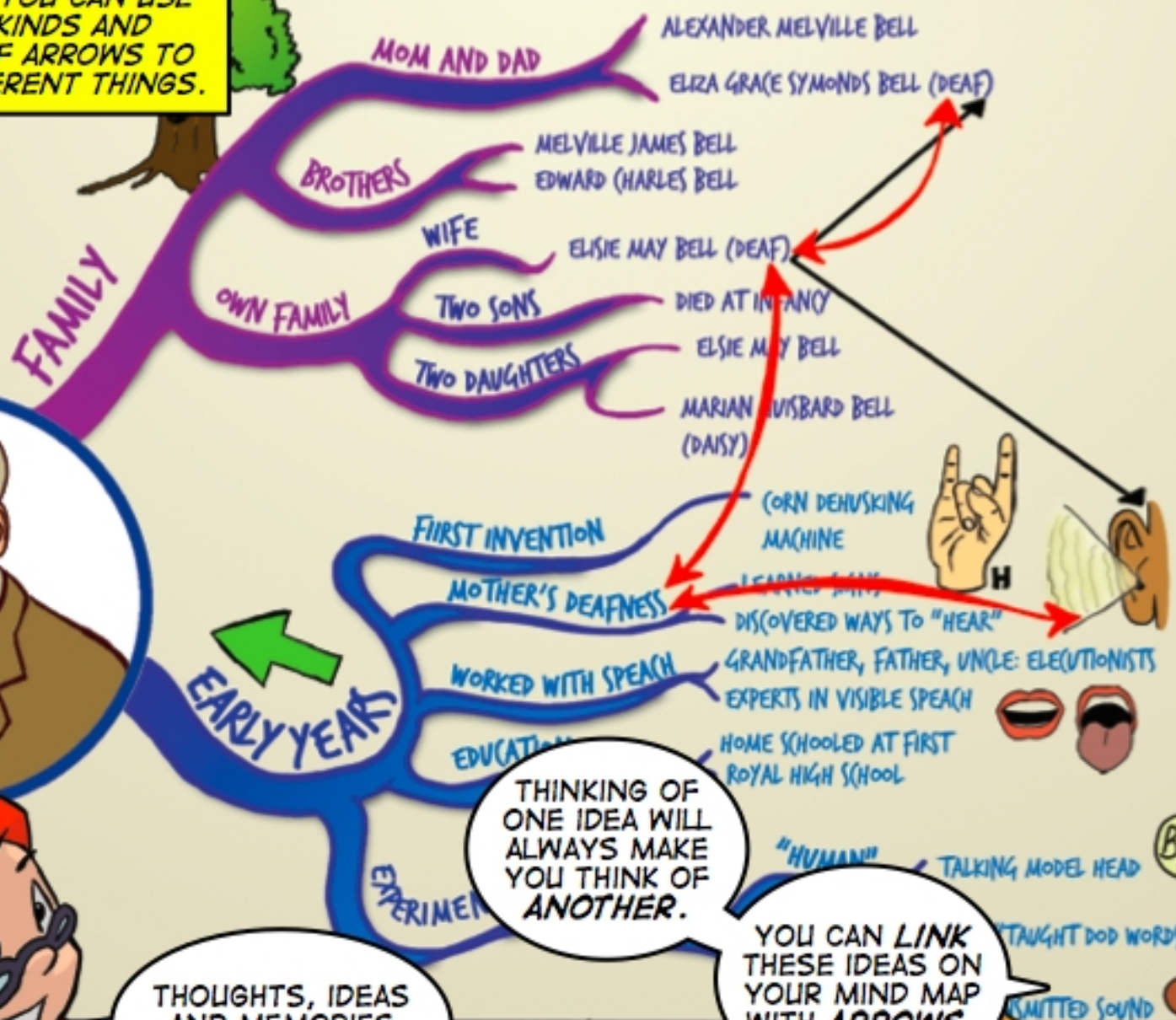


THE BRANCHES AREN'T EVERYTHING. BECAUSE YOU DON'T THINK ONLY IN WORDS.

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.

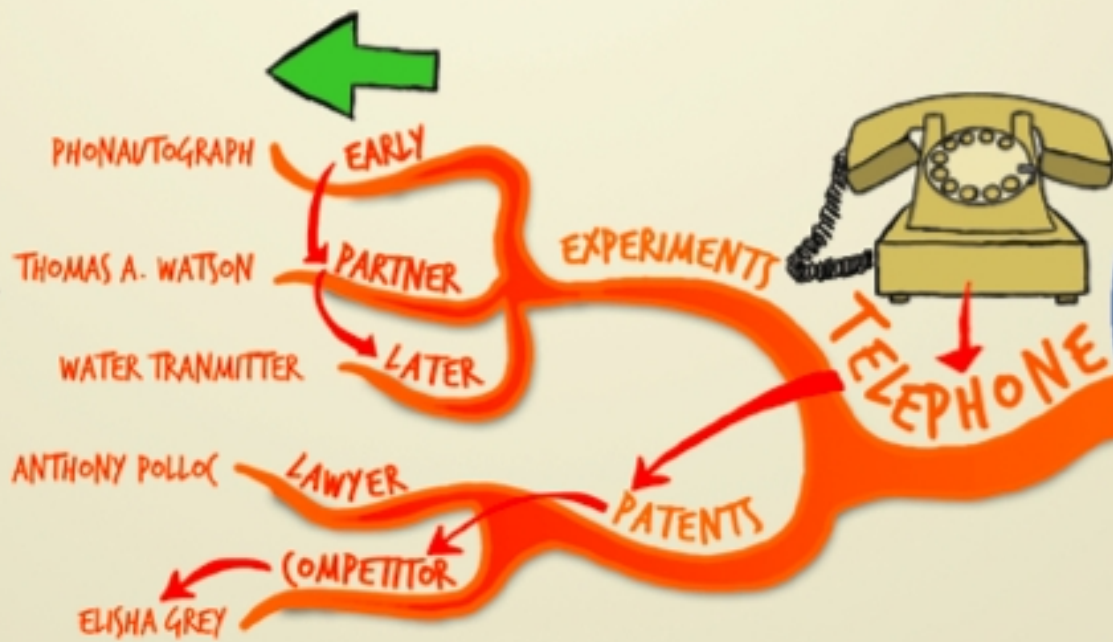
STEP 4: USE ARROWS TO LINK COMMON IDEAS TOGETHER. YOU CAN USE DIFFERENT KINDS AND COLOURS OF ARROWS TO SHOW DIFFERENT THINGS.



THOUGHTS, IDEAS AND MEMORIES AREN'T ISLANDS.

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

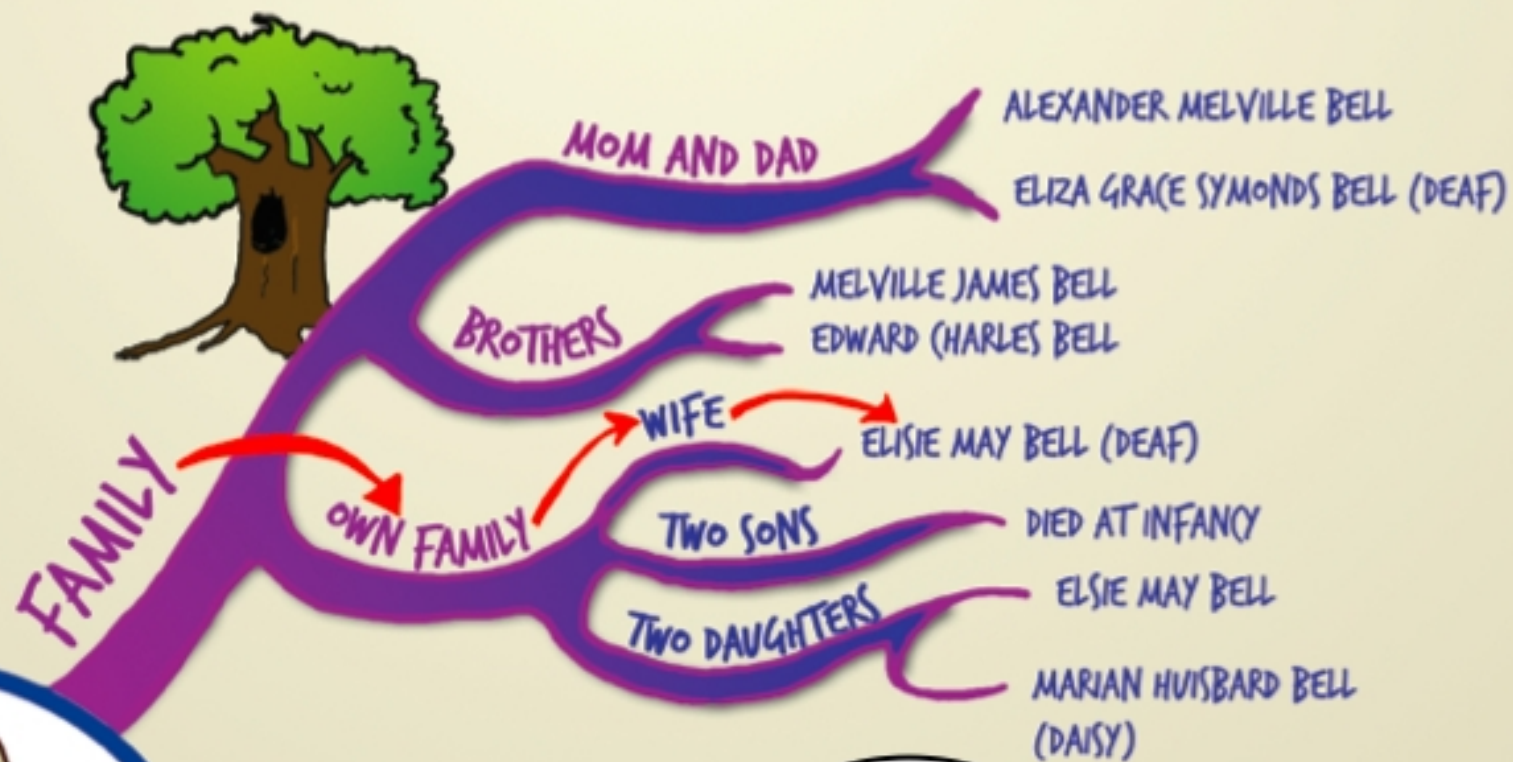
YOU CAN LINK THESE IDEAS ON YOUR MIND MAP WITH ARROWS.



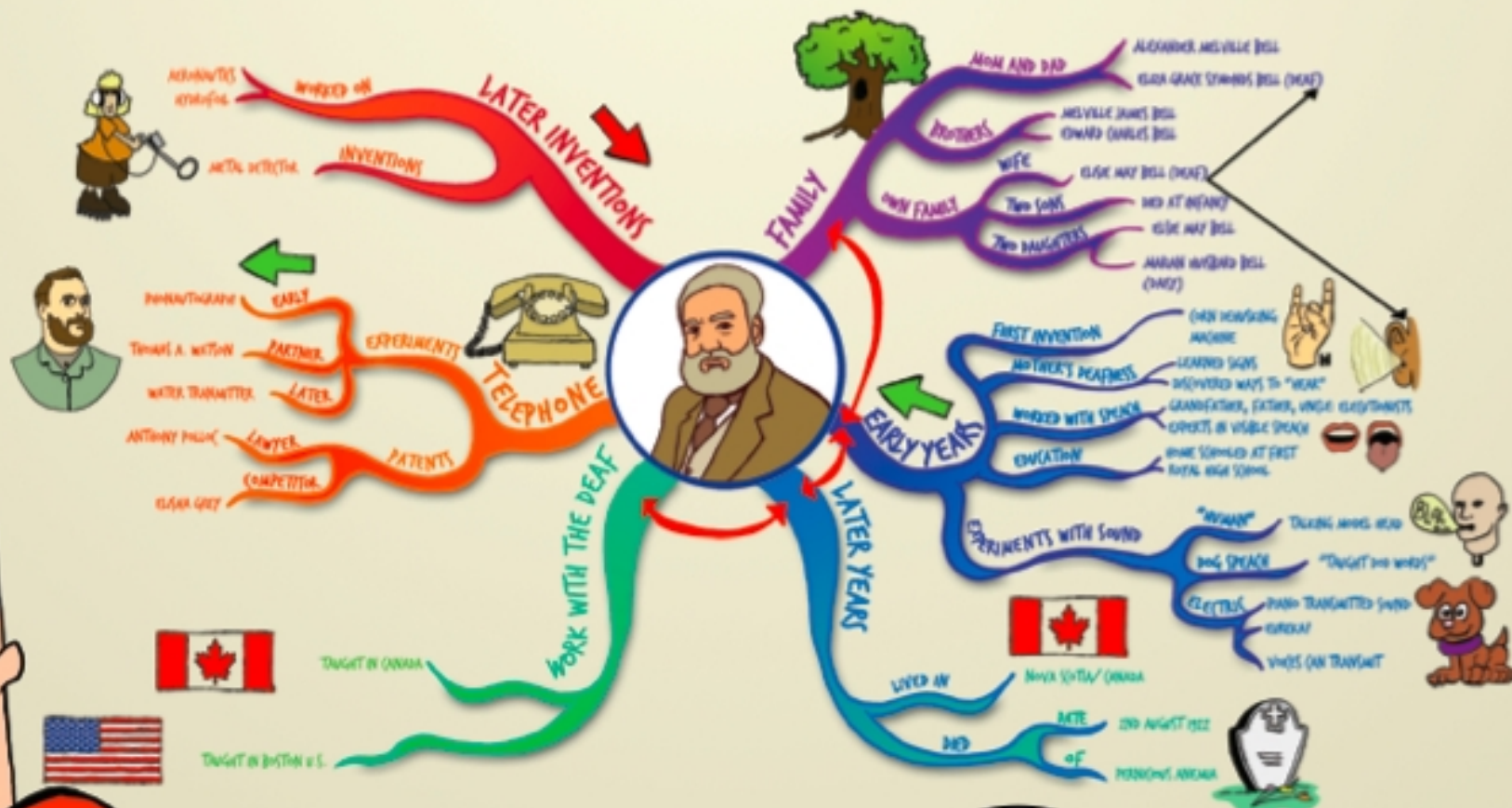
YOU CAN USE
LINK FACTS FROM
**DIFFERENT IDEA
BRANCHES.**

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



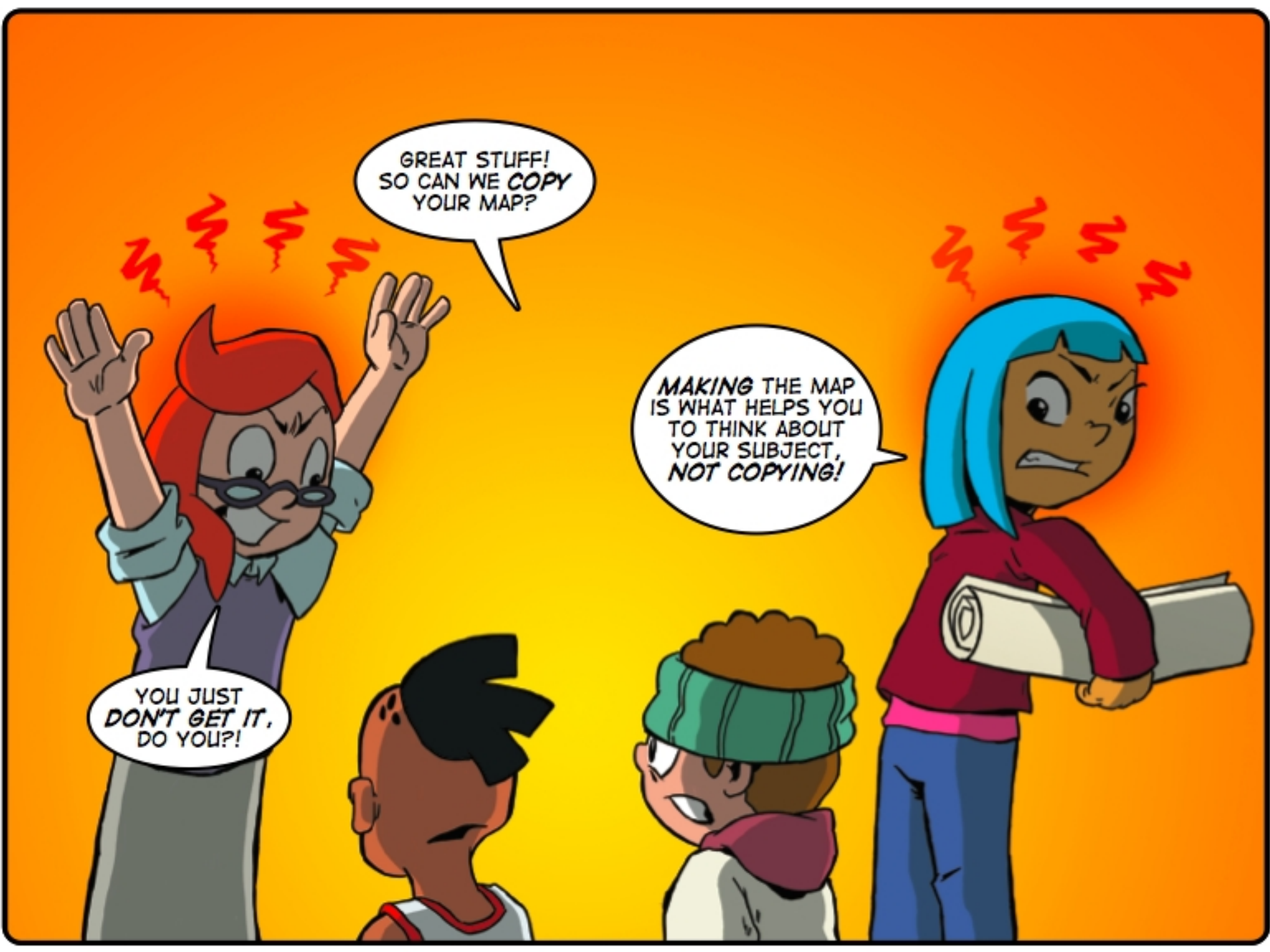


AND DON'T
FORGET THAT THE
MORE **SPECIFIC**
YOUR **IDEAS**
BECOME, YOU
SHOULD MAKE YOUR
BRANCHES
THINNER.



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?

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

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.

WHY THE LONG FACE?

SHAKAS

J g h c w
u A b a
K R
D Z S y L



GOOD READERS
ARE PEOPLE WHO
ENJOY READING.

I'M TRYING TO
READ ABOUT **SHAKA
ZULL'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**!



A woman with red hair and glasses is talking to a boy. She is holding a book and a piece of paper with a drawing of a tree. The boy is looking at her with a skeptical expression.

SO DOES
THAT HELP
YOU?

LIKE YOU
WON'T BELIEVE,
SOPH!

A boy is holding a beach ball and a book. He is smiling and looking up at the beach ball. The background is a bright orange with white rays.

BECAUSE 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.

WOW! I WONDER WHAT MAKES IT BOUNCE LIKE THAT?

YEAH! I WONDER HOW MANY TIMES A NORMAL BALL BOUNCES?

GOOD SCIENTISTS BEGIN WITH A QUESTION. THEY WANT TO DISCOVER AN ANSWER TO SOME MYSTERY.

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 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.

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?



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