INCREDIBLE SCIENTISTS, SENSATIONAL DISCOVERIES

- in comics -

MARIE CURIE AND THE RADIOACTIVITY

16

ADRIANA MOURA

ADRIANA MOURA

MARIE CURIE AND THE RADIOACTIVITY

INCREDIBLE SCIENTISTS, SENSATIONAL DISCOVERIES

- in comics -

Editora ATOMUS

Belo Horizonte
2018

Site:
http://cientistasquadrinhos.com
e-mail:
cientistasquadrinhos@gmail.com

IMAGES OUT OF SCALE SIZE

Authorized illustration: Http://www.bitstripsforschools.com

PROLOGUE

Scientists have been working hard for broadening human-boundary knowledge and have been giving mankind the best of life perspective. Their theories change the thoughts and persuade mankind life.

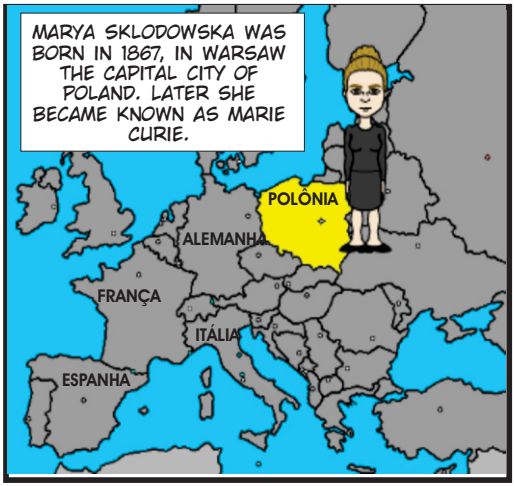
A theory is the picture of a big idea based, mainly, towards observation. Each new discovery becomes part of the author life story.

Scientific ideas have been faced overturning towards the years because people incredibly and persistently broke old conceptions stuck in the traditions as well presenting a new way of thinking. However, every scientific idea that is considered the truth nowadays is susceptible to be changed, fairly enough, it is necessary that someone come up with a new conception, being determined and find out a way of convincingly proving the new hypothesis. There are many questions to the new generation of scientists to be answered that will change the world. This comic collection has gotten the objective for promoting the learning basic concepts of science towards the science history, into an attractive manner, pleasant, as well as with an easy and understanding language, contributing to improve scientific education.

At the end of each adventure there is a chapter dubbed "now you are the scientist". They are activities related to the story you have just read for training and that allure the reader to put themselves into the scientist shoes and other exercises for being debated in groups.

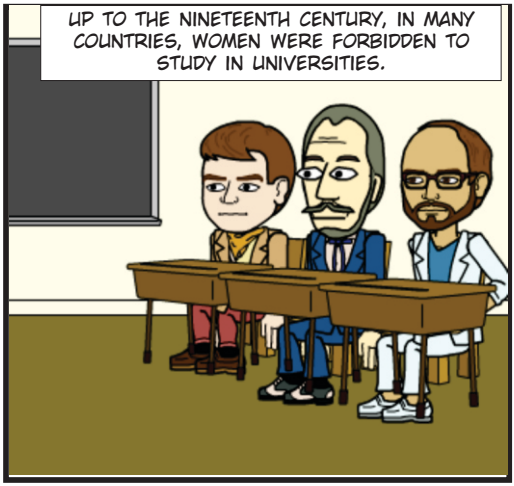
Adriana Moura
Licensed and Bachelor in Biologics Science – UFMG
Master-degree in Science (specialization) – UFMG
Teacher at Belo Horizonte Municipal City Hall
Vice-Director and Director at Israel Pinheiro Municipal School / 2003 – 2006
Coordinator teacher for Integrated School Program
Israel Pinheiro Municipal School / 2007 - 2015
Member of the Directorate of Integral Education - Municipal Education
Secretariat / since 2015
Coordinator of the BH Eco-School Program / since 2016

MARYA SKLODOWSKA WAS BORN IN 1867, IN WARSAW THE CAPITAL CITY OF POLAND. LATER SHE BECAME KNOWN AS MARIE CURIE.



RESEARCH AND SCIENCE WAS NOT THE TASK OF ANY WOMEN. WOMEN WERE FOR GETTING MARRIED, TAKE CARE OF THEIR KIDS AND HOUSE.

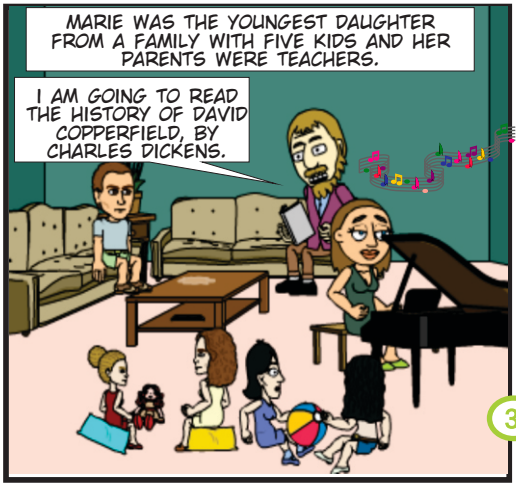
UP TO THE NINETEENTH CENTURY, IN MANY COUNTRIES, WOMEN WERE FORBIDDEN TO STUDY IN UNIVERSITIES.



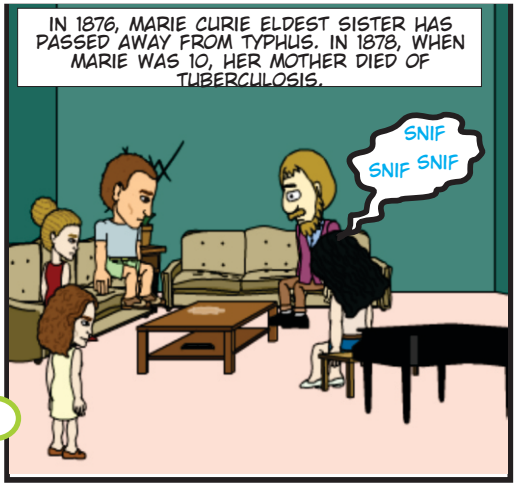
IT WAS IN THAT TIME WHEN MARIE CURIE LIVED. SHE WAS THE FIRST WOMAN TO RECEIVE THE NOBEL PRIZE*

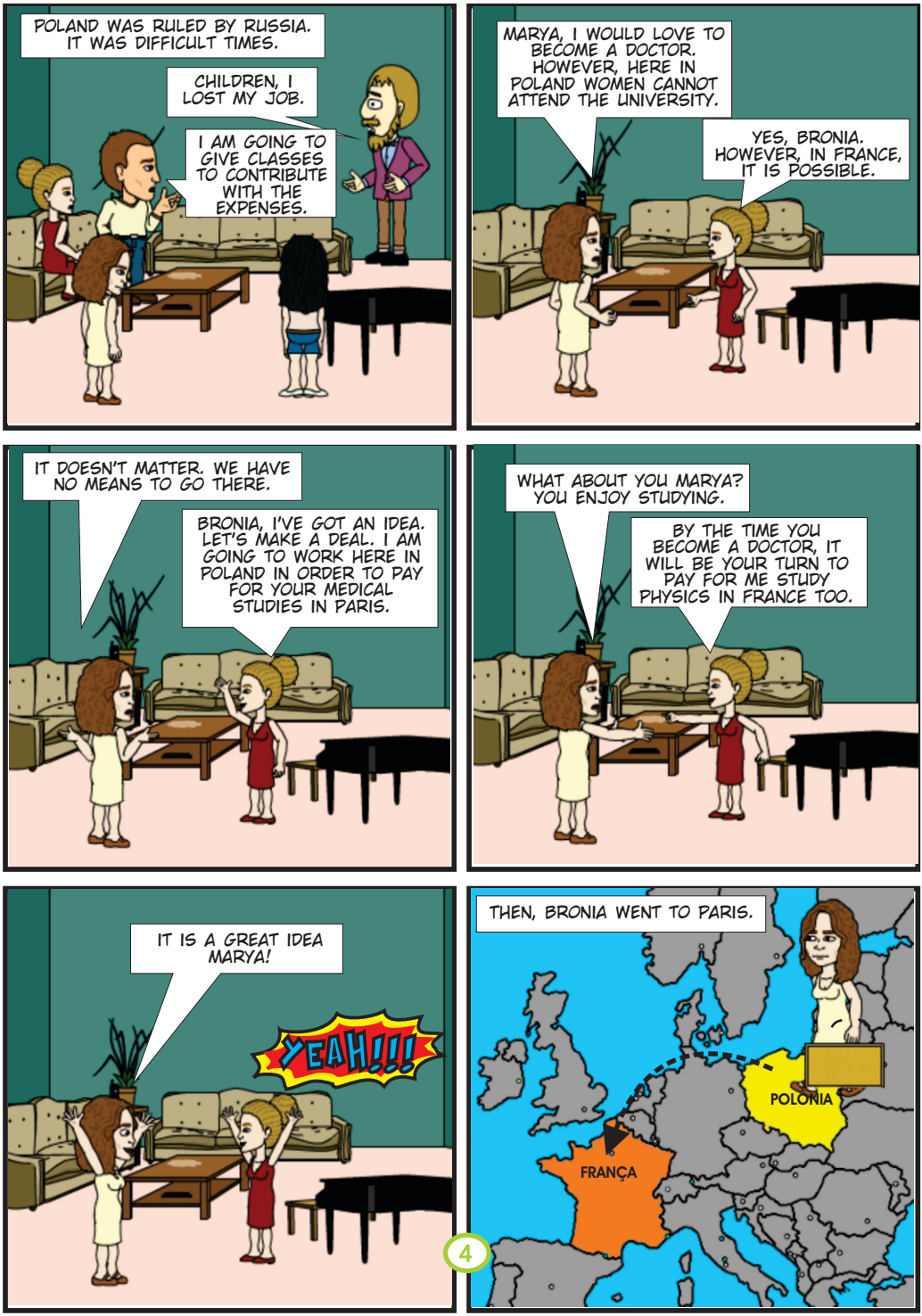
* NOBEL PRIZE IS THE ONE OF MOST IMPORTANT AWARD IN THE WORLD, GRANTED ANNUALLY TO THE BEST SCIENTIST WHO IS THE MOST PROMINENT.

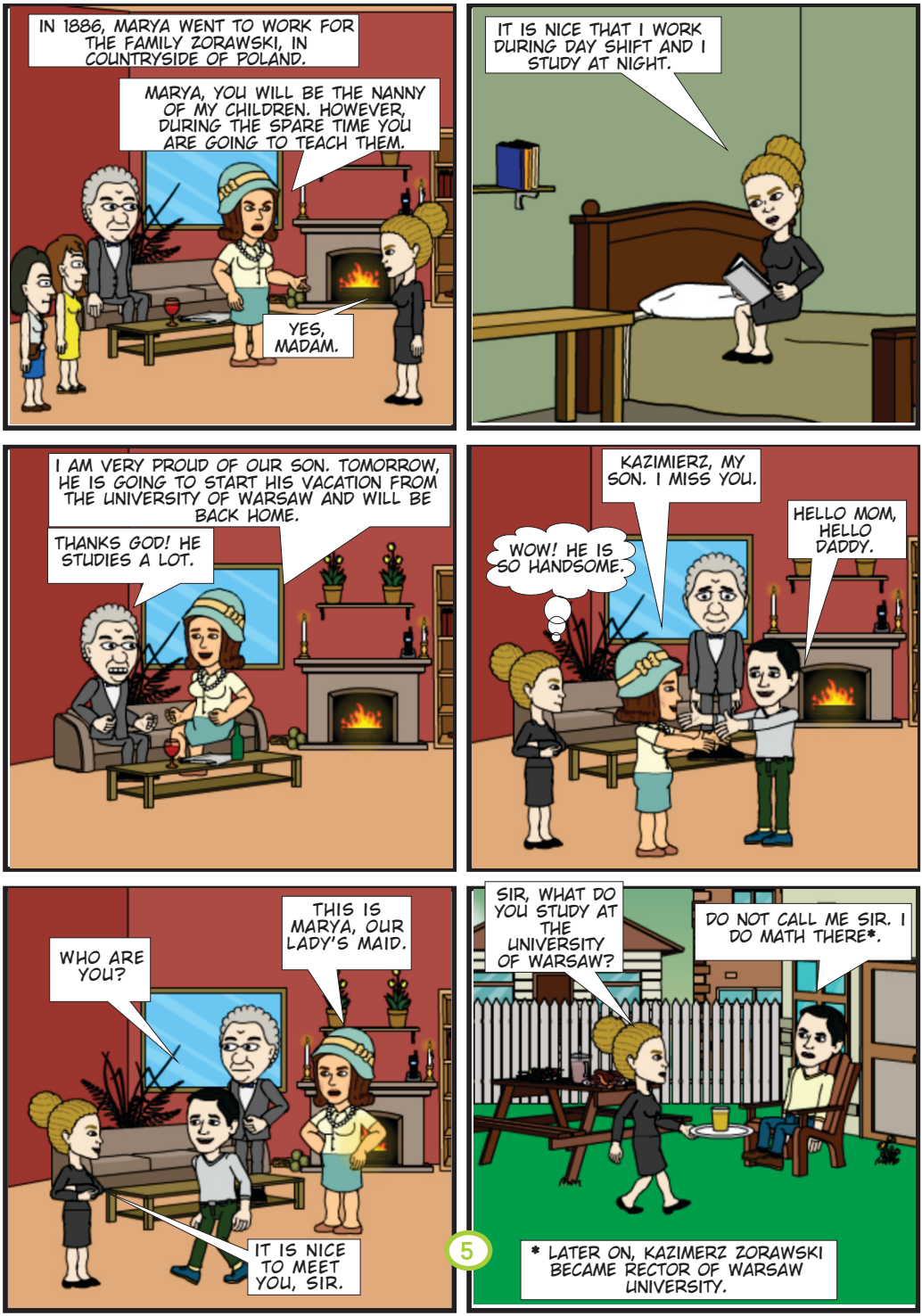
MARIE WAS THE YOUNGEST DAUGHTER FROM A FAMILY WITH FIVE KIDS AND HER PARENTS WERE TEACHERS.

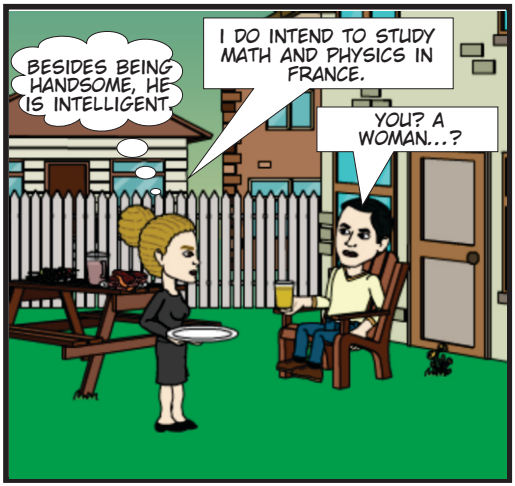


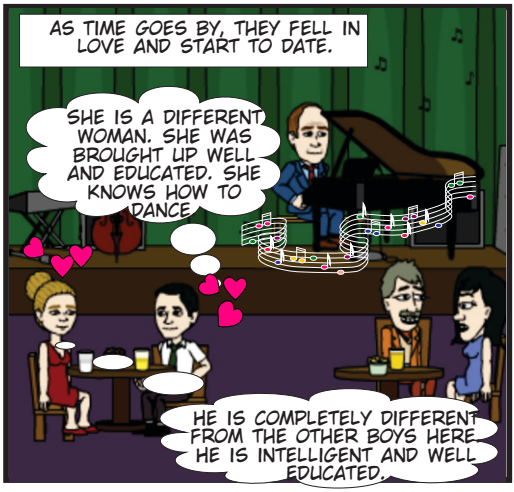
IN 1876, MARIE CURIE ELDEST SISTER HAS PASSED AWAY FROM TYPHUS. IN 1878, WHEN MARIE WAS 10, HER MOTHER DIED OF TUBERCULOSIS.

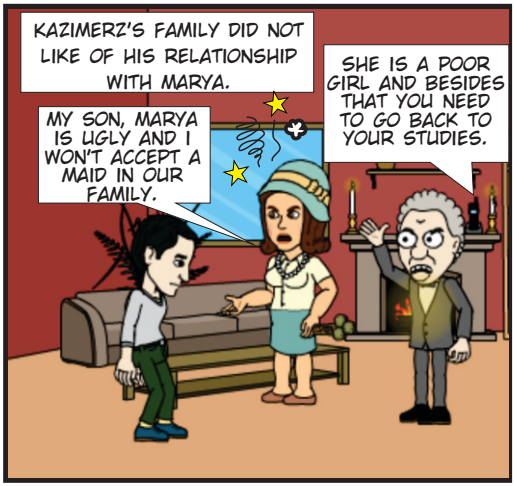


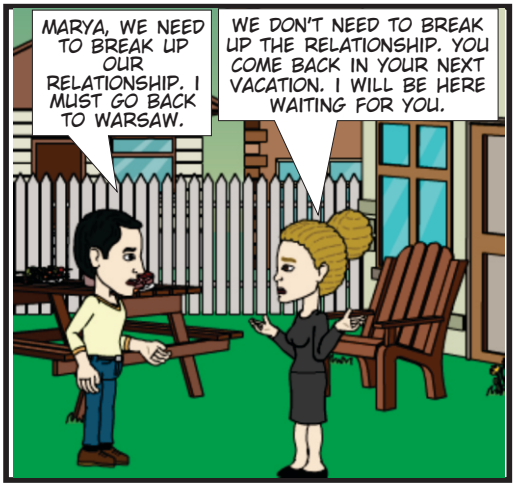

POLAND WAS RULED BY RUSSIA. IT WAS DIFFICULT TIMES.
CHILDREN, I LOST MY JOB.
I AM GOING TO GIVE CLASSES TO CONTRIBUTE WITH THE EXPENSES.
MARYA, I WOULD LOVE TO BECOME A DOCTOR. HOWEVER, HERE IN POLAND WOMEN CANNOT ATTEND THE UNIVERSITY.
YES, BRONIA. HOWEVER, IN FRANCE, IT IS POSSIBLE.
IT DOESN'T MATTER. WE HAVE NO MEANS TO GO THERE.
BRONIA, I'VE GOT AN IDEA. LET'S MAKE A DEAL. I AM GOING TO WORK HERE IN POLAND IN ORDER TO PAY FOR YOUR MEDICAL STUDIES IN PARIS.
WHAT ABOUT YOU MARYA? YOU ENJOY STUDYING.
BY THE TIME YOU BECOME A DOCTOR, IT WILL BE YOUR TURN TO PAY FOR ME STUDY PHYSICS IN FRANCE TOO.
IT IS A GREAT IDEA MARYA!
YEAH!!!
THEN, BRONIA WENT TO PARIS.
POLÔNIA
FRANÇA

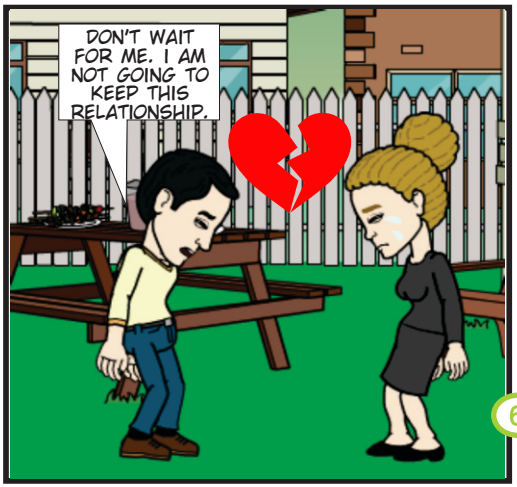

IN 1886, MARYA WENT TO WORK FOR THE FAMILY ZORAWSKI, IN COUNTRYSIDE OF POLAND.
MARYA, YOU WILL BE THE NANNY OF MY CHILDREN. HOWEVER, DURING THE SPARE TIME YOU ARE GOING TO TEACH THEM.
YES, MADAM.
IT IS NICE THAT I WORK DURING DAY SHIFT AND I STUDY AT NIGHT.
I AM VERY PROUD OF OUR SON. TOMORROW, HE IS GOING TO START HIS VACATION FROM THE UNIVERSITY OF WARSAW AND WILL BE BACK HOME.
THANKS GOD! HE STUDIES A LOT.
KAZIMIERZ, MY SON. I MISS YOU.
WOW! HE IS SO HANDSOME.
HELLO MOM, HELLO DADDY.
THIS IS MARYA, OUR LADY'S MAID.
WHO ARE YOU?
IT IS NICE TO MEET YOU, SIR.
SIR, WHAT DO YOU STUDY AT THE UNIVERSITY OF WARSAW?
DO NOT CALL ME SIR. I DO MATH THERE*.
* LATER ON, KAZIMERZ ZORAWSKI BECAME RECTOR OF WARSAW UNIVERSITY.

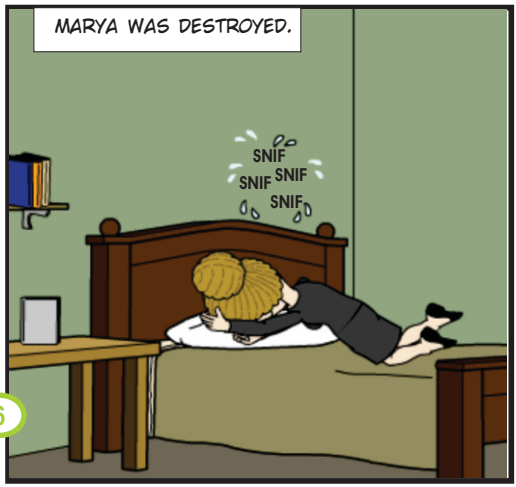

BESIDES BEING HANDSOME, HE IS INTELLIGENT.
I DO INTEND TO STUDY MATH AND PHYSICS IN FRANCE.
YOU? A WOMAN...?

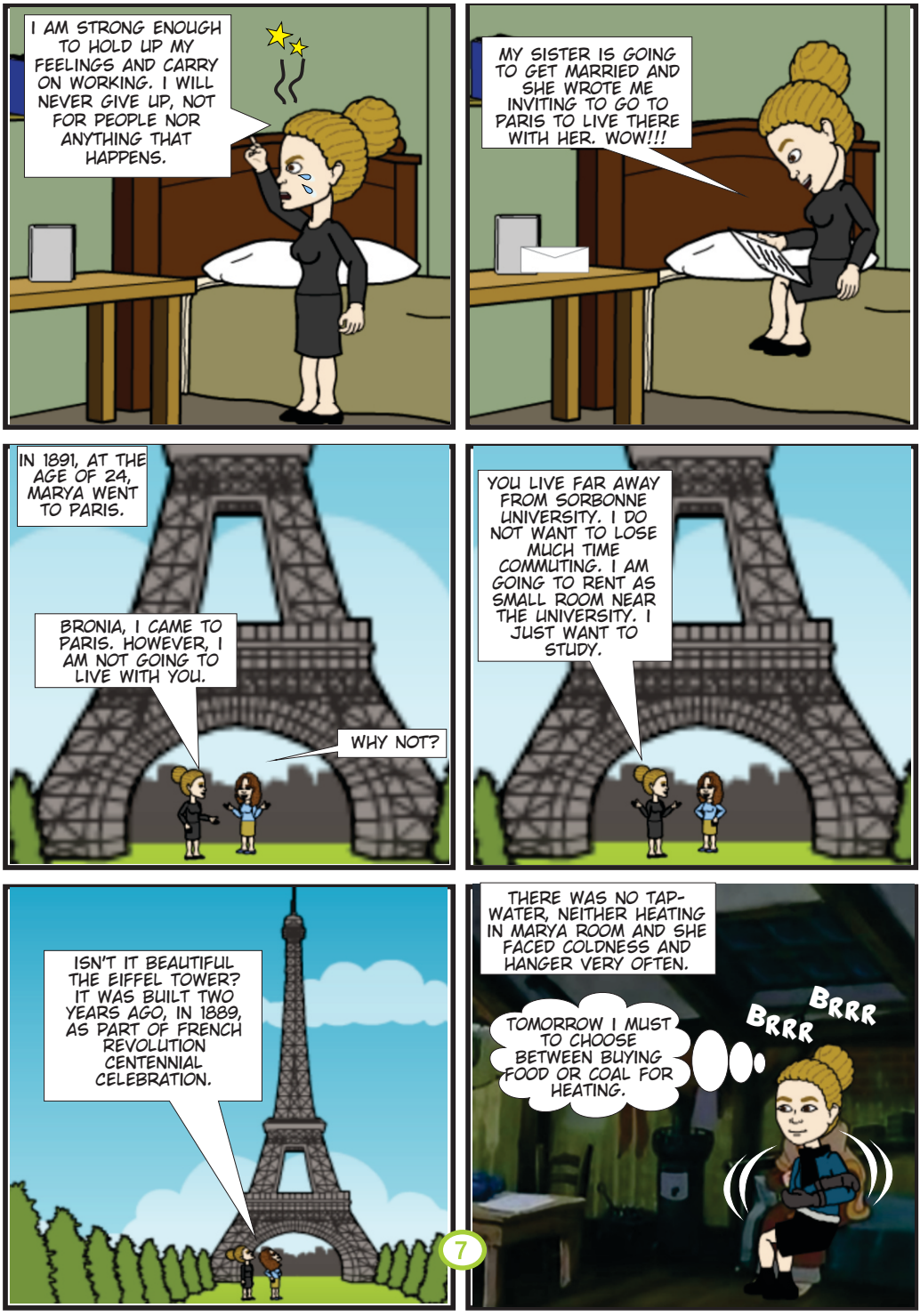

AS TIME GOES BY, THEY FELL IN LOVE AND START TO DATE.
SHE IS A DIFFERENT WOMAN. SHE WAS BROUGHT UP WELL AND EDUCATED. SHE KNOWS HOW TO DANCE
HE IS COMPLETELY DIFFERENT FROM THE OTHER BOYS HERE. HE IS INTELLIGENT AND WELL EDUCATED.


KAZIMERZ'S FAMILY DID NOT LIKE OF HIS RELATIONSHIP WITH MARYA.
MY SON, MARYA IS UGLY AND I WON'T ACCEPT A MAID IN OUR FAMILY.
SHE IS A POOR GIRL AND BESIDES THAT YOU NEED TO GO BACK TO YOUR STUDIES.

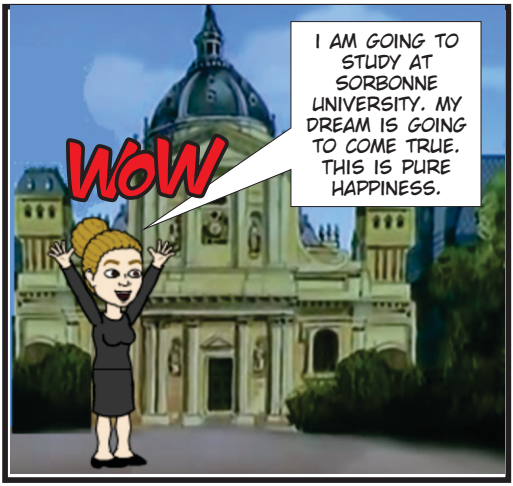

MARYA, WE NEED TO BREAK UP OUR RELATIONSHIP. I MUST GO BACK TO WARSAW.
WE DON'T NEED TO BREAK UP THE RELATIONSHIP. YOU COME BACK IN YOUR NEXT VACATION. I WILL BE HERE WAITING FOR YOU.

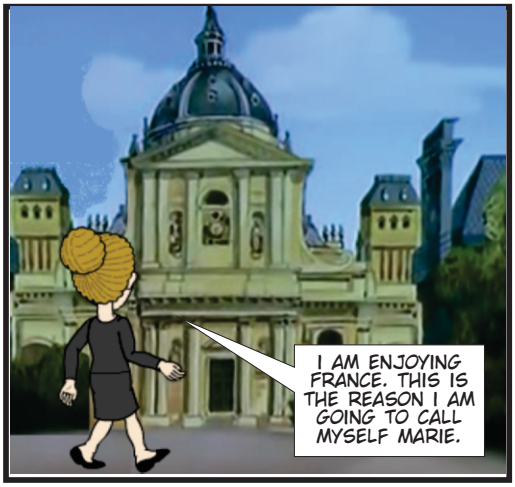

DON'T WAIT FOR ME. I AM NOT GOING TO KEEP THIS RELATIONSHIP.

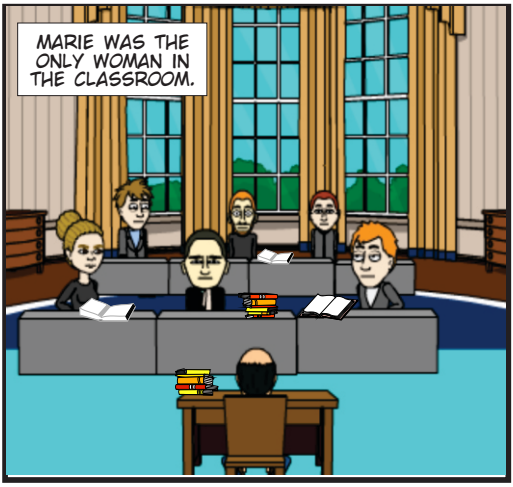

MARYA WAS DESTROYED.
SNIF
SNIF SNIF
SNIF

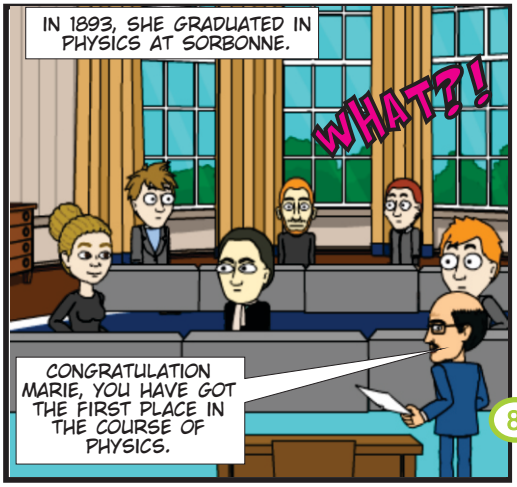

I AM STRONG ENOUGH TO HOLD UP MY FEELINGS AND CARRY ON WORKING. I WILL NEVER GIVE UP, NOT FOR PEOPLE NOR ANYTHING THAT HAPPENS.
MY SISTER IS GOING TO GET MARRIED AND SHE WROTE ME INVITING TO GO TO PARIS TO LIVE THERE WITH HER. WOW!!!
IN 1891, AT THE AGE OF 24, MARYA WENT TO PARIS.
BRONIA, I CAME TO PARIS. HOWEVER, I AM NOT GOING TO LIVE WITH YOU.
WHY NOT?
YOU LIVE FAR AWAY FROM SORBONNE UNIVERSITY. I DO NOT WANT TO LOSE MUCH TIME COMMUTING. I AM GOING TO RENT AS SMALL ROOM NEAR THE UNIVERSITY. I JUST WANT TO STUDY.
ISN'T IT BEAUTIFUL THE EIFFEL TOWER? IT WAS BUILT TWO YEARS AGO, IN 1889, AS PART OF FRENCH REVOLUTION CENTENNIAL CELEBRATION.
THERE WAS NO TAP-WATER, NEITHER HEATING IN MARYA ROOM AND SHE FACED COLDNESS AND HANGER VERY OFTEN.
TOMORROW I MUST TO CHOOSE BETWEEN BUYING FOOD OR COAL FOR HEATING.
BRRR
BRRR
7

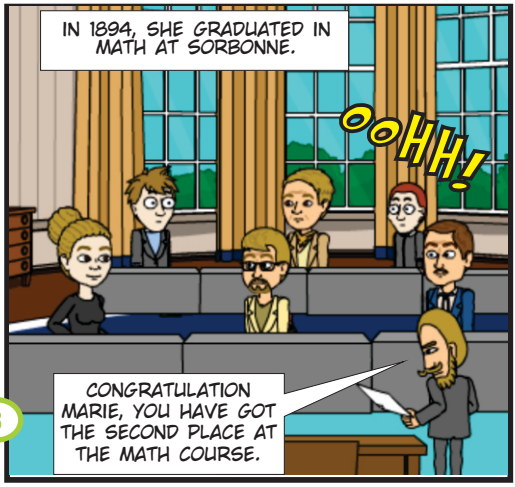

EVEN THOUGH...
HERE I AM COMPLETELY FREE FOR STUDYING. I AM VERY HAPPY BECAUSE I DO WHATEVER I WANT.

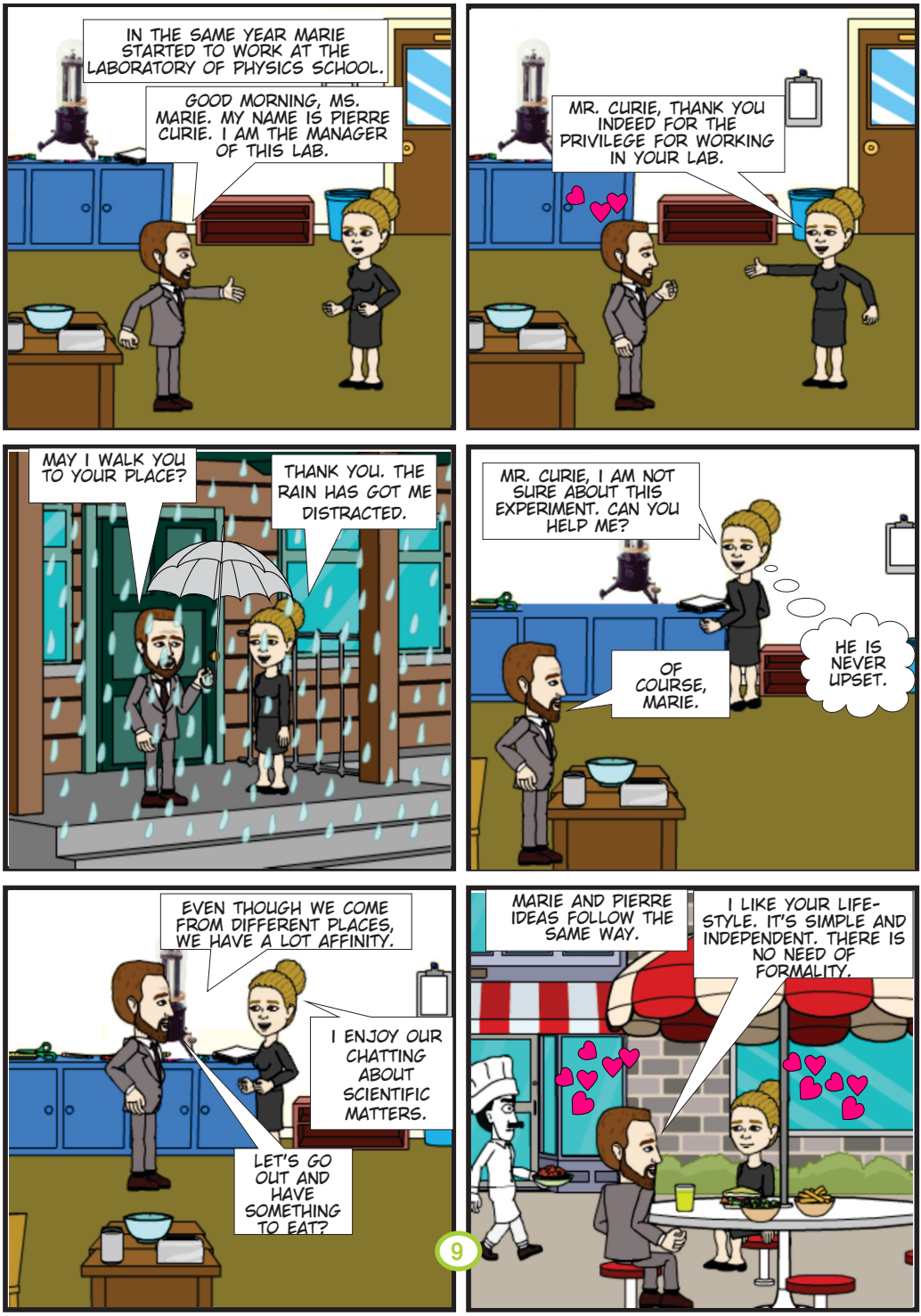

WOW
I AM GOING TO STUDY AT SORBONNE UNIVERSITY. MY DREAM IS GOING TO COME TRUE. THIS IS PURE HAPPINESS.

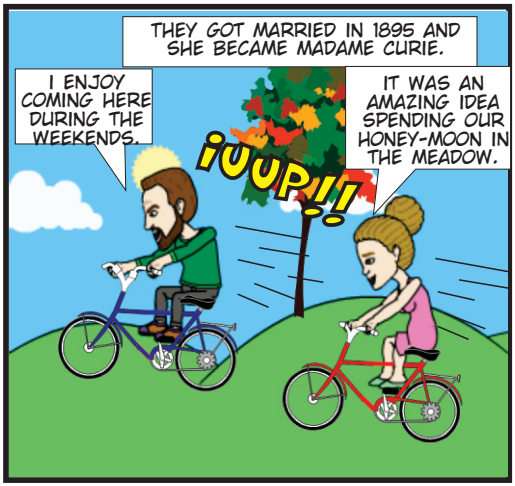

I AM ENJOYING FRANCE. THIS IS THE REASON I AM GOING TO CALL MYSELF MARIE.


MARIE WAS THE ONLY WOMAN IN THE CLASSROOM.


IN 1893, SHE GRADUATED IN PHYSICS AT SORBONNE.
WHAT?!
CONGRATULATION MARIE, YOU HAVE GOT THE FIRST PLACE IN THE COURSE OF PHYSICS.


IN 1894, SHE GRADUATED IN MATH AT SORBONNE.
OOHH!
CONGRATULATION MARIE, YOU HAVE GOT THE SECOND PLACE AT THE MATH COURSE.


IN THE SAME YEAR MARIE STARTED TO WORK AT THE LABORATORY OF PHYSICS SCHOOL.
GOOD MORNING, MS. MARIE. MY NAME IS PIERRE CURIE. I AM THE MANAGER OF THIS LAB.
MR. CURIE, THANK YOU INDEED FOR THE PRIVILEGE FOR WORKING IN YOUR LAB.
MAY I WALK YOU TO YOUR PLACE?
THANK YOU. THE RAIN HAS GOT ME DISTRACTED.
MR. CURIE, I AM NOT SURE ABOUT THIS EXPERIMENT. CAN YOU HELP ME?
OF COURSE, MARIE.
HE IS NEVER UPSET.
EVEN THOUGH WE COME FROM DIFFERENT PLACES, WE HAVE A LOT AFFINITY.
I ENJOY OUR CHATTING ABOUT SCIENTIFIC MATTERS.
LET'S GO OUT AND HAVE SOMETHING TO EAT?
MARIE AND PIERRE IDEAS FOLLOW THE SAME WAY.
I LIKE YOUR LIFE-STYLE. IT'S SIMPLE AND INDEPENDENT. THERE IS NO NEED OF FORMALITY.



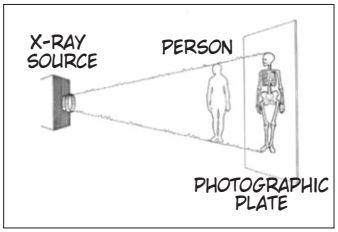
DURING THE FIRST YEARS OF MR. AND MRS. CURIE MARRIAGE, SCIENCE BECOMES TO TRANSFORM RADICALLY.

FIRST X-RAY

WILHELM RÖNTGEN

IN 1895, THE GERMAN PHYSICIST WILHELM RÖNTGEN DISCOVERED THE X-RAY AND RECEIVES THE NOBEL PRIZE FOR THAT.

THE X-RAY IS A TYPE OF INVISIBLE LIGHT THAT CAN CROSS SOLID MATERIALS AS PAPER, WOOD, METAL AND EVEN THOUGH HUMAN BODY.



ANY PHOTOGRAPHIC PLACE BECOME DARK WHEN EXPOSED TO ANY TYPE OF LIGHT.

WHEN AN X-RAY IS EMANATED THROUGH THE HUMAN BODY, THE PHOTOGRAPHIC PLATE REPLICATES THE HUMAN BODY IMAGE.

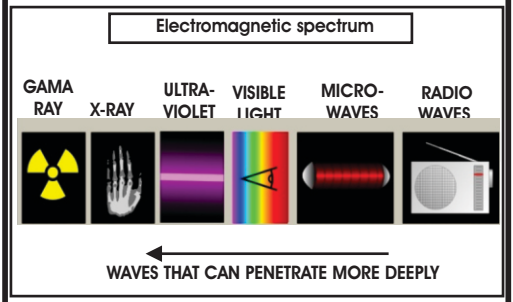
THE HUMAN FLESH BECOMES DARK BECAUSE THE MAJOR PART OF THE RAYS PASSES THROUGH IT.

THE BONES BECOME LIGHTER BECAUSE A MINOR QUANTITY OF THE RAYS GOES THROUGH THE BONES.

I AM GOING TO CALL IT X-RAY BECAUSE I DON'T KNOW ITS PHYSICAL PROPERTIES.

IN 1912, MAX THEODOR, PROVED THAT THE X-RAYS ARE ELECTROMAGNETIC RADIATIONS FROM HIGH ENERGY.

ELECTROMAGNETIC WAVES FROM X-RAY ARE DIFFERENT FROM ELECTROMAGNETIC WAVES AND DIFFERENT FROM VISIBLE LIGHT RAYS AS WELL AS FROM RADIO WAVES BECAUSE THE CARRY HIGH ENERGY, WHICH CONTRIBUTE TO THE RAY ITSELF PENETRATE INTO SOLID MATERIAL.



THE DISCOVERY OF X-RAY HAS THRILLED THE ENTIRE WORLD. X-RAY WAS USED INDISCRIMINATELY. NOBODY KNEW HOW DANGER HIGH DOSES OF X-RAY WERE THAT MAY DAMAGE THE HUMAN TISSUE EVEN THOUGH CAUSES CANCER.

NOWADAYS, THERE IS A NEED FOR USING LEAD-APRON (LEAD BLOCK X-RAY THROUGH IT) FOR PROTECTION WHEN HANDLING X-RAY IN HOSPITAL.

X-RAY CARRIES SEVERAL APPLICATIONS: MEDICINE, PHYSIC, ASTROPHYSICS, ASTRONOMY AND METALLURGIC INDUSTRY.

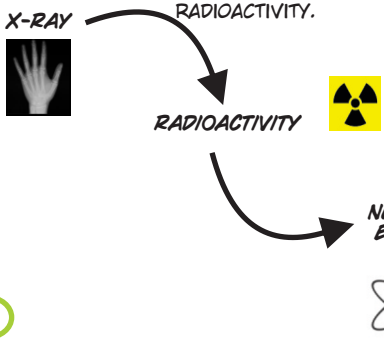
IT CAN DETECT CRACKS OR STRUCTURAL DEFECT IN SOME DEVICES

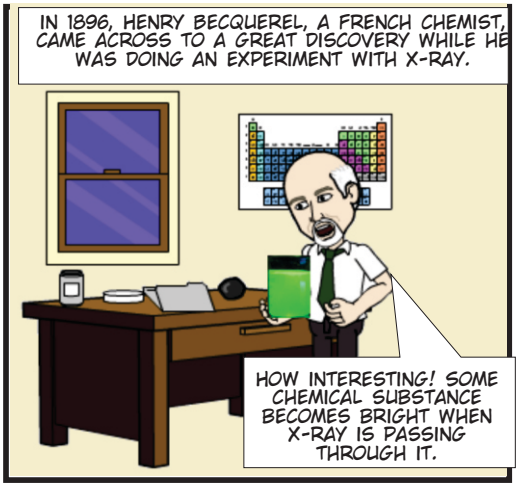
BROKEN BONES

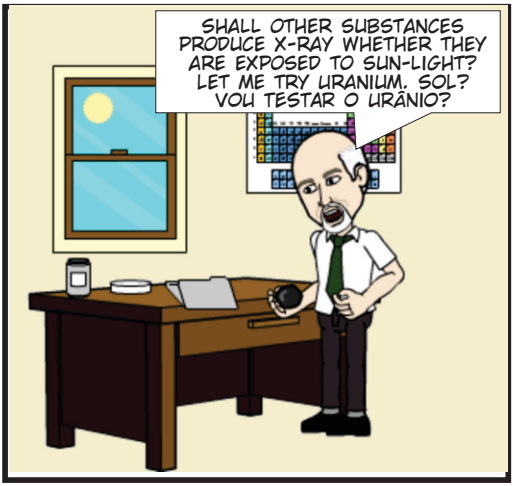
IT IS POSSIBLE TO SEE THE INSIDE OF THE BODY WITHOUT MAKING CUTS

IT CAN BE USED IN AIRPORTS TO EXAMINE THE INTERIOR OF LUGGAGE ALLOWING SAFETY AND SPEEDING.

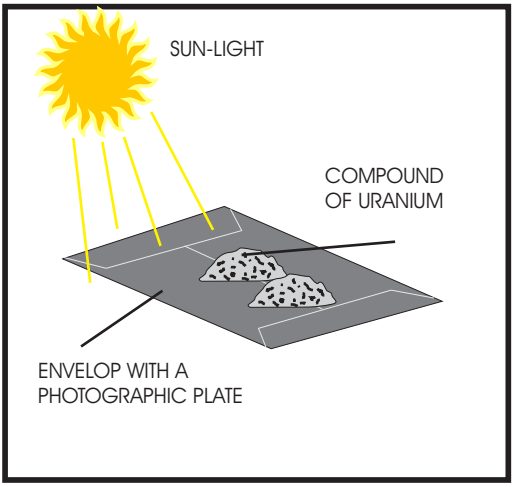
THE DISCOVERY OF X-RAY HAS REVOLUTIONIZED MEDICAL TREATMENT WHICH STARTS THE MODERN AGE OF PHYSICS. IT HELPS MARIE CURIE WITH THE DISCOVERY OF RADIOACTIVITY.

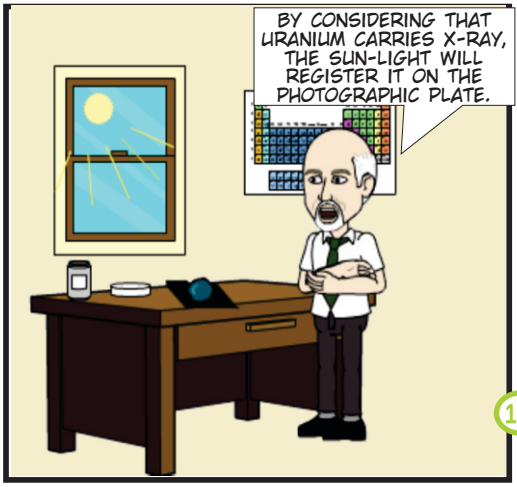


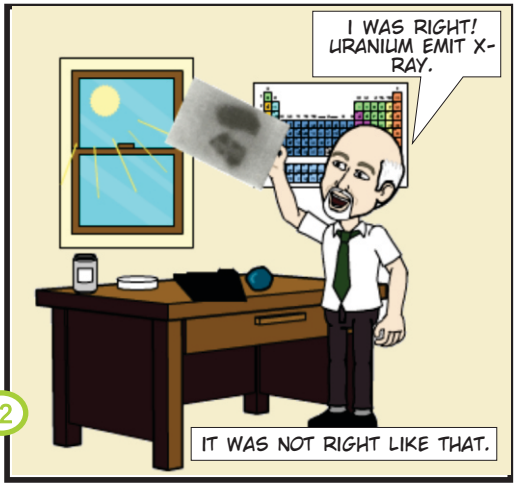

IN 1896, HENRY BECQUEREL, A FRENCH CHEMIST, CAME ACROSS TO A GREAT DISCOVERY WHILE HE WAS DOING AN EXPERIMENT WITH X-RAY.
HOW INTERESTING! SOME CHEMICAL SUBSTANCE BECOMES BRIGHT WHEN X-RAY IS PASSING THROUGH IT.


SHALL OTHER SUBSTANCES PRODUCE X-RAY WHETHER THEY ARE EXPOSED TO SUN-LIGHT? LET ME TRY URANIUM. SOL? VOU TESTAR O URÂNIO?


LET ME WRAP THIS PHOTOGRAPHIC PLATE INTO BLACK-PAPER AND ON THE TOP OF THAT PLACE A COMPOUND OF URANIUM AND THEN I WILL EXPOSE IT TO SUN-LIGHT.


SUN-LIGHT
COMPOUND OF URANIUM
ENVELOP WITH A PHOTOGRAPHIC PLATE


BY CONSIDERING THAT URANIUM CARRIES X-RAY, THE SUN-LIGHT WILL REGISTER IT ON THE PHOTOGRAPHIC PLATE.


I WAS RIGHT! URANIUM EMIT X-RAY.
IT WAS NOT RIGHT LIKE THAT.

TODAY, THERE IS NO SUN-SHINE. THERE IS NO WAY TO DO THE EXPERIMENT. SO, I WILL LEAVE EVERYTHING READY TO WHEN THE SUN SHINES AGAIN.

I WILL PLACE IT ON THIS DRAWER.

SEVERAL DAYS WITHOUT SUN-SHINE HAVE GONE.

HOW SAD! WITHOUT THE SUN-SHINE I CANNOT WORK.

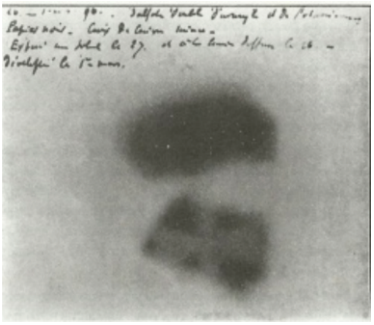
LET ME SEE IF THE PLATES ARE SAFE STORED.

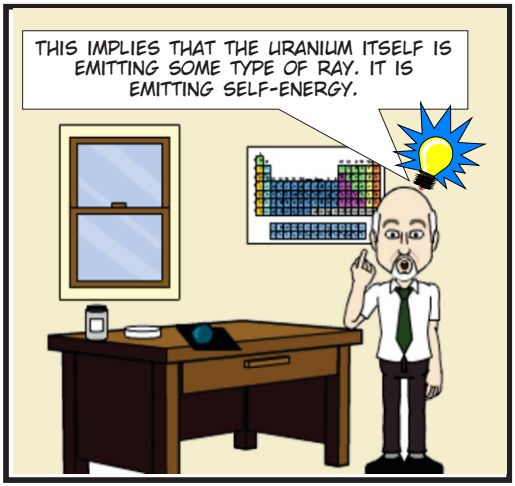
BUT FOR HIS SURPRISE...

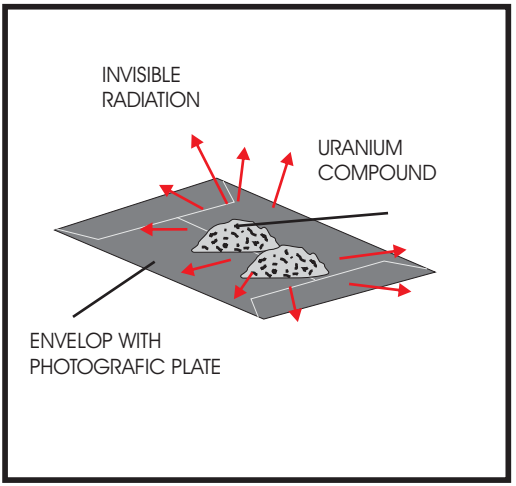
WOW. EVEN THOUGH, WITHOUT THE SUN-SHINE THE URANIUM IMAGE WAS TRANSFERRED TO THE PHOTOGRAPHIC PLATE.

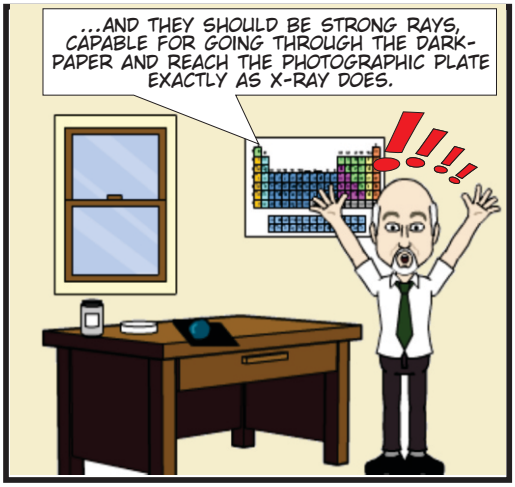
WOW

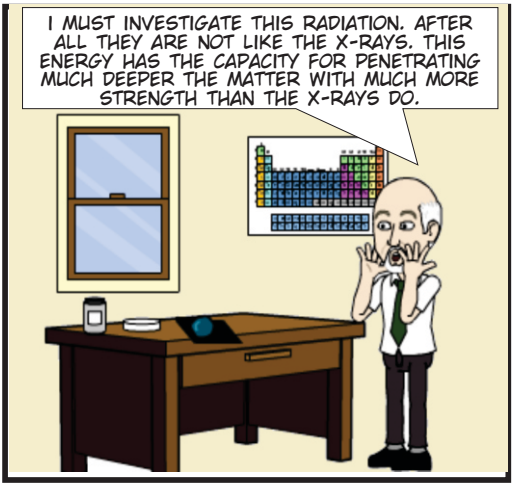
THE FILM USED BY BECQUEREL ON HIS DISCOVERY, THE DARK STAIN REFERS TO THE PLACE WHERE THE RADIATION REACHES MORE. THIS MATERIAL IS PRESERVED UP TO NOWADAYS AT THE POLYTECHNIC SCHOOL IN PARIS.

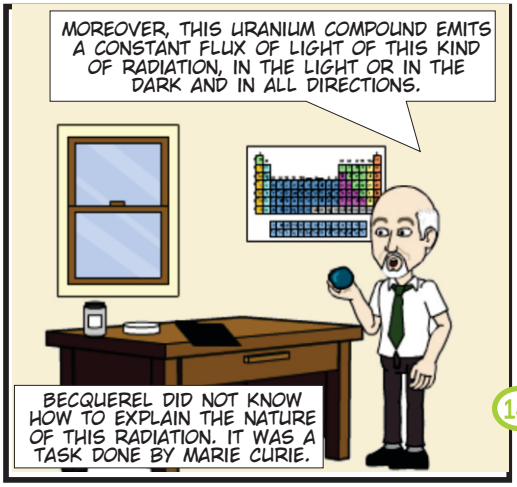


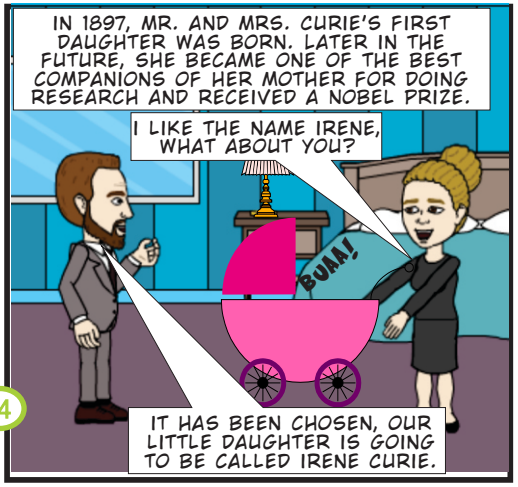

THIS IMPLIES THAT THE URANIUM ITSELF IS EMITTING SOME TYPE OF RAY. IT IS EMITTING SELF-ENERGY.


INVISIBLE RADIATION
URANIUM COMPOUND
ENVELOP WITH PHOTOGRAFIC PLATE


...AND THEY SHOULD BE STRONG RAYS, CAPABLE FOR GOING THROUGH THE DARK-PAPER AND REACH THE PHOTOGRAPHIC PLATE EXACTLY AS X-RAY DOES.


I MUST INVESTIGATE THIS RADIATION. AFTER ALL THEY ARE NOT LIKE THE X-RAYS. THIS ENERGY HAS THE CAPACITY FOR PENETRATING MUCH DEEPER THE MATTER WITH MUCH MORE STRENGTH THAN THE X-RAYS DO.


MOREOVER, THIS URANIUM COMPOUND EMITS A CONSTANT FLUX OF LIGHT OF THIS KIND OF RADIATION, IN THE LIGHT OR IN THE DARK AND IN ALL DIRECTIONS.
BECQUEREL DID NOT KNOW HOW TO EXPLAIN THE NATURE OF THIS RADIATION. IT WAS A TASK DONE BY MARIE CURIE.


IN 1897, MR. AND MRS. CURIE'S FIRST DAUGHTER WAS BORN. LATER IN THE FUTURE, SHE BECAME ONE OF THE BEST COMPANIONS OF HER MOTHER FOR DOING RESEARCH AND RECEIVED A NOBEL PRIZE.
I LIKE THE NAME IRENE, WHAT ABOUT YOU?
BUAA!
IT HAS BEEN CHOSEN, OUR LITTLE DAUGHTER IS GOING TO BE CALLED IRENE CURIE.

MARIE, IT IS ABOUT TIME FOR YOU TO GO BACK ON YOUR RESEARCHES.

OF COURSE! I FIND VERY INTERESTING RÖNTGEN AND BECQUEREL DISCOVERIES.

I WAS THINKING ABOUT WHAT COULD BE THE NATURE OF THAT RADIATION. WHAT ARE THOSE RAYS? WHAT KIND ENERGY IS IT AND WHERE DOES IT COME FROM?

YES, YOU ARE RIGHT. BECQUEREL DID NOT EXPLAIN THAT.

uHEE

AND WHY THESE RAYS ARE EMITTED FROM A MINERAL? IS THERE ANYTHING IN THIS MINERAL THAT RELEASES THE RAYS ITSELF?

POWERFUL RAYS TO CROSS THROUGH THE DARK-PAPER AND ALTER THE PHOTOGRAPHIC PLATE. IT'S LIKE THERE WAS A PIECE OF SUN INSIDE THE ROCK.

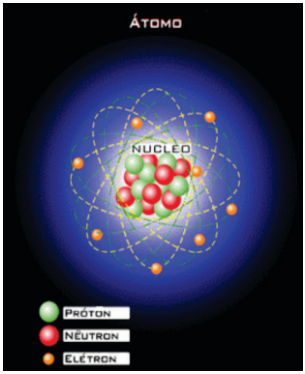
AFTER SOME EXPERIMENTATION BEING DONE...

THE RAY-POWER IS DIRECTLY IN PROPORTION TO THE AMOUNT OF URANIUM THAT COMPRISES THE MINERAL.

WHAT YOU ARE SAYING IS THAT THE HIGHER THE QUANTITY OF URANIUM, THE HIGHER IS THE QUANTITY OF RADIATION?

THAT'S IT! THE SOURCE OF RADIATION IS NOT THE MINERAL ITSELF. THE RADIATION IS EMITTED FROM INNER PART OF THE ATOMS OF URANIUM.

THIS DISCOVERY STARTS THE DEVELOPMENT OF NUCLEAR PHYSICS STUDIES.



SHALL URANIUM BE THE UNIQUE ELEMENT THAT CARRIES THIS CHARACTERISTIC OF EMITTING RADIATION? I WILL FIND OUT.

AND SO...

PIERRE, THORIUM, ANOTHER CHEMICAL ELEMENT WHICH CARRIES THE SAME CHARACTERISTIC. I AM GOING TO CALL THIS CAPACITY OF RADIATION EMISSION 'RADIOACTIVITY'.

RADIOACTIVITY: ACTIVE RAY PENETRATING PROPERTY.

NOT SO LONG AFTER MARIE DISCOVERY. ERNEST RUTHERFORD, FROM NEW ZEALAND, PROVED THAT THE RADIOACTIVE ATOM EMITS THREE TYPES OF RAYS: ALFA, BETA AND GAMMA.

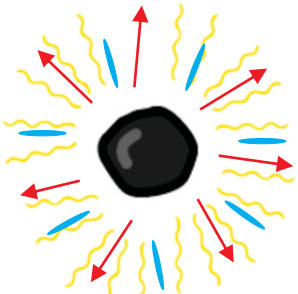
RADIOACTIVITY IS THE CAPACITY OF UNSTABLE ATOMS FREE ENERGY UNDER RADIATION FORM (FREED ENERGY).

RUTHERFORD RECEIVED THE NOBEL PRIZE IN 1908.

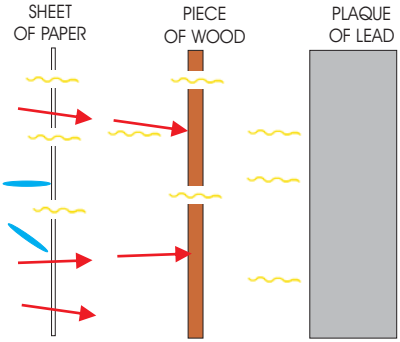
ALFA RAYS ARE ABLE TO GO THROUGH A SHEET OF PAPER.

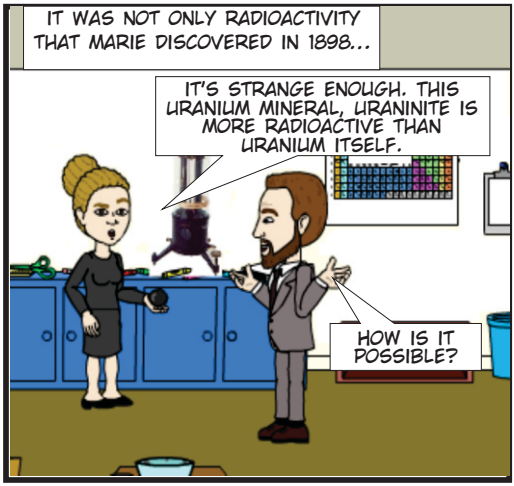
BETA RAYS ARE ABLE TO GO DEEPER BUT CAN BE BLOCKED BY A PIECE OF WOOD 2,5CM. (1INCH)

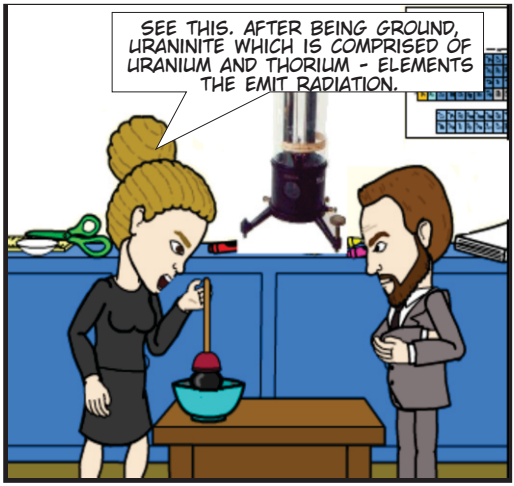
GAMMA RAYS ARE EXTREMELY PENETRATING AND ENERGETIC.
GAMMA RAYS ARE BLOCKED ONLY BY THICK PLAQUE OF LEAD.

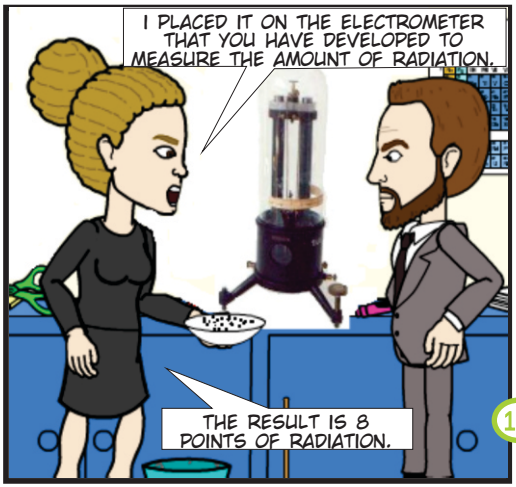


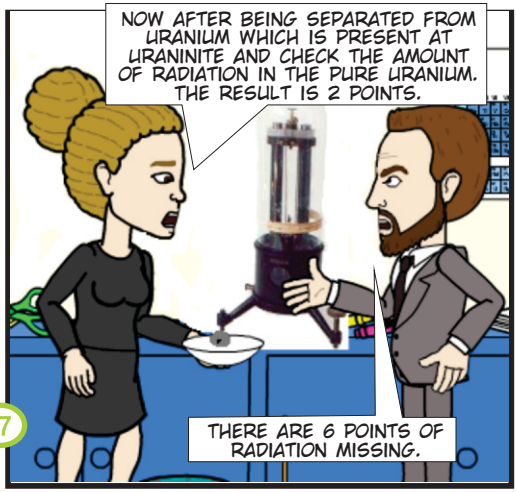
SCIENCE STARTS THE NUCLEAR ENERGY ERA.

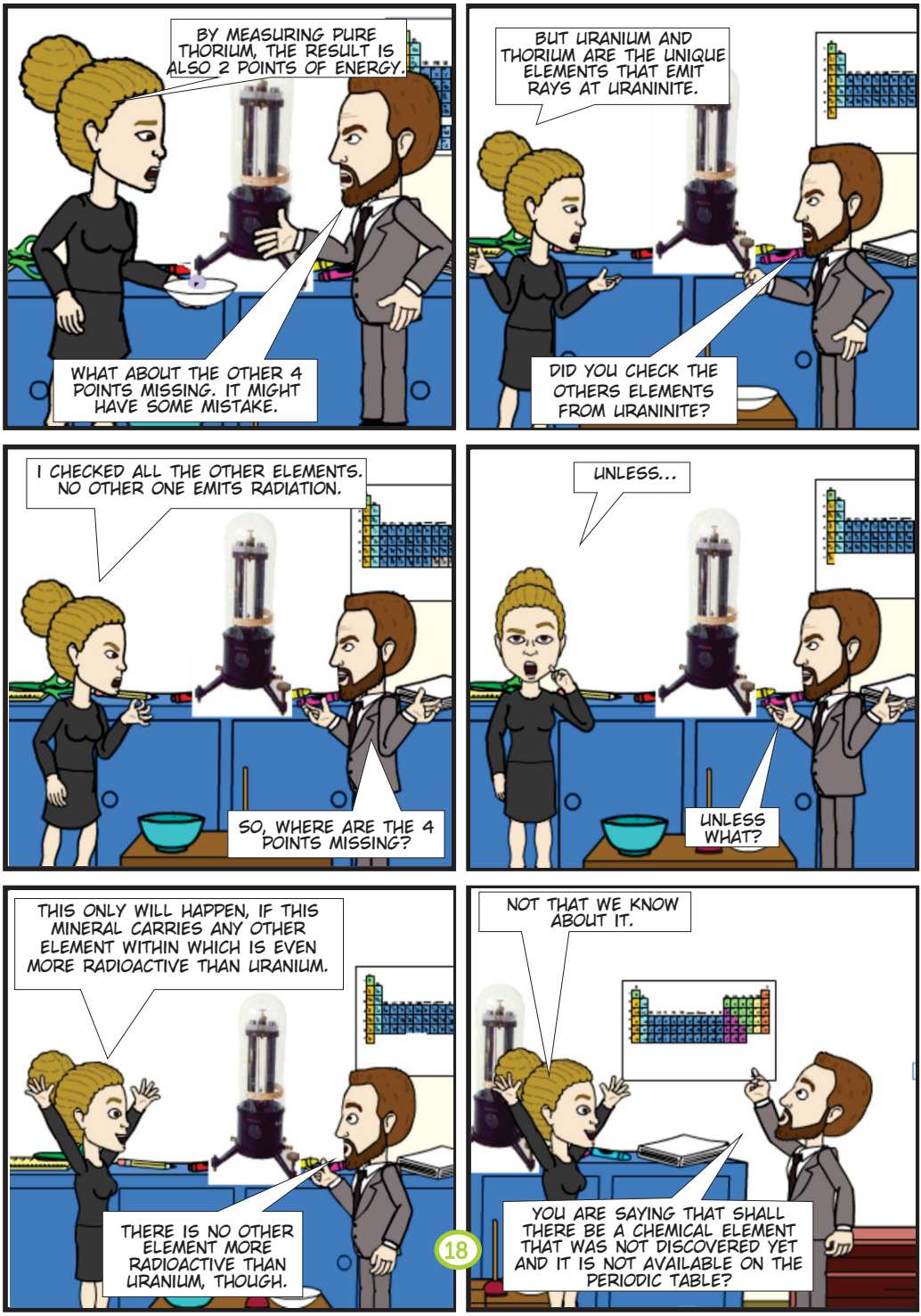











BY MEASURING PURE THORIUM, THE RESULT IS ALSO 2 POINTS OF ENERGY.
WHAT ABOUT THE OTHER 4 POINTS MISSING. IT MIGHT HAVE SOME MISTAKE.
BUT URANIUM AND THORIUM ARE THE UNIQUE ELEMENTS THAT EMIT RAYS AT URANINITE.
DID YOU CHECK THE OTHERS ELEMENTS FROM URANINITE?
I CHECKED ALL THE OTHER ELEMENTS. NO OTHER ONE EMITS RADIATION.
SO, WHERE ARE THE 4 POINTS MISSING?
UNLESS...
UNLESS WHAT?
THIS ONLY WILL HAPPEN, IF THIS MINERAL CARRIES ANY OTHER ELEMENT WITHIN WHICH IS EVEN MORE RADIOACTIVE THAN URANIUM.
THERE IS NO OTHER ELEMENT MORE RADIOACTIVE THAN URANIUM, THOUGH.
NOT THAT WE KNOW ABOUT IT.
YOU ARE SAYING THAT SHALL THERE BE A CHEMICAL ELEMENT THAT WAS NOT DISCOVERED YET AND IT IS NOT AVAILABLE ON THE PERIODIC TABLE?

DURING THE TIME THAT MARIE CURIE STARTED HER STUDIES; THE SCIENTISTS ONLY KNOW 83 CHEMICAL ELEMENTS.

PERIODIC TABLE

1												13	14	15	16	17	18
H	2																He
Li	Be											B	C	N	O	F	Ne
Na	Mg	3	4	5	6	7	8	9	10	11	12	Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi			

La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu

EXACTLY. IF THIS ELEMENT EXISTS, IT MAY BE PRESENT IN VERY LOW QUANTITIES CONSIDERING THAT NOBODY HAS IDENTIFIED IT YET.

IT WOULD BE A GREAT DISCOVERY AND EXTREMELY SIGNIFICANT TO THE WORLD.

IF YOU SEPARATED ALL ELEMENTS FROM URANINITE, WHERE IS THE OTHER ELEMENT?

IN THE GARBAGE.

WHAT?

?!?!?

DURING THE SEPARATION PROCESS, THE LAST STEP IS FILTRATION. THEN, THE OTHER ELEMENT MIGHT BE ON THE PAPER I USE TO FILTER AND AFTER THAT I THROW IT AWAY.

HERE YOU ARE!

GARBAGE

HOW COME, THERE IS NOTHING THERE.

LET'S PLACE IT IN THE ELECTROMETER AND MEASURE IT.

GARBAGE

FOUR! THERE ARE THE 4 POINTS MISSING.

HOORAY! WE DISCOVER A NEW RADIOACTIVE CHEMICAL ELEMENT!

WOW

IN TRUTH, IN 1889, THEY DISCOVERED TWO NEW CHEMICAL ELEMENTS.

THIS NEW ELEMENT IS GOING TO BE CALLED POLONIUM. IN HONOR TO MY HOMELAND POLAND*.

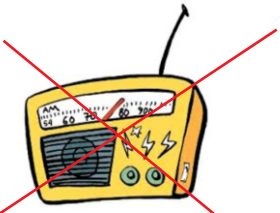
WHAT ABOUT THE OTHER?

* MARIE CURIE ALWAYS LOVES POLAND.

WHAT ABOUT CALL THE OTHER CHEMICAL ELEMENT 'RADIO', DUE TO THE HIGH LEVEL OF RADIOACTIVITY?

POLONIUM IS 400 TIMES MORE RADIOACTIVE THAN URANIUM.

AND THE RADIO* IS 1M TIMES MORE RADIOACTIVE THAN URANIUM.

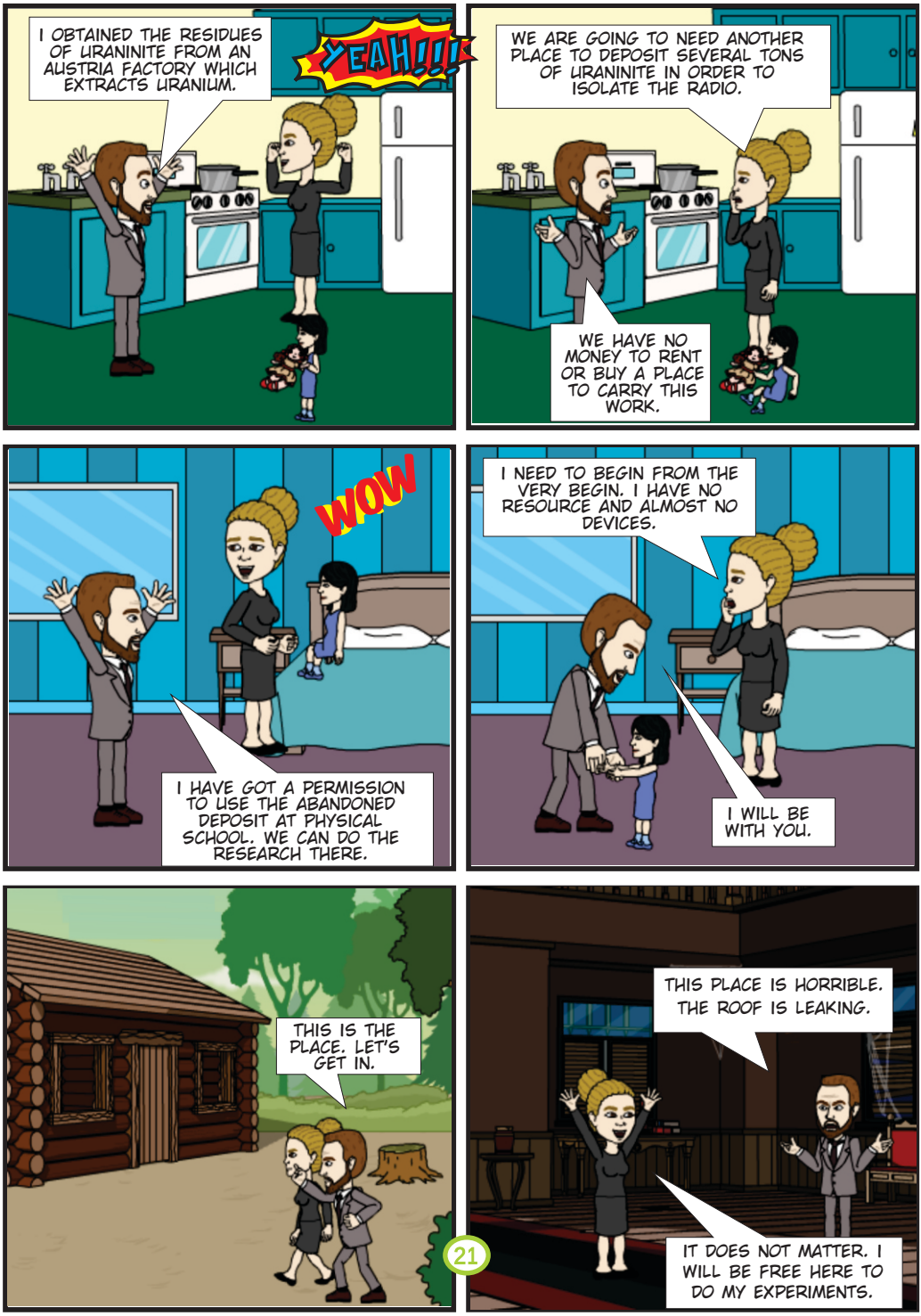


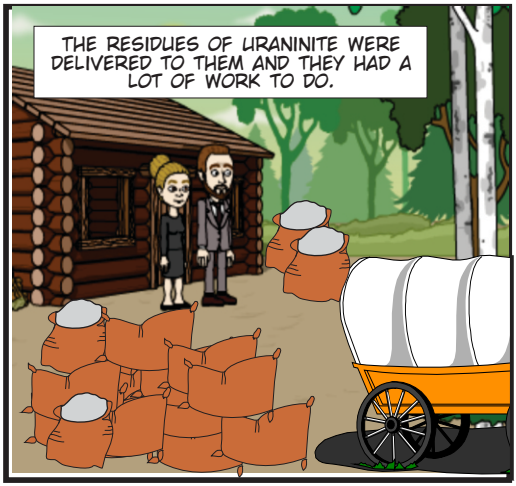
* DO NOT MISTAKENLY TAKE RADIO THAT BROADCAST MUSIC WITH THE CHEMICAL ELEMENT DISCOVERED BY MARIE AND PIERRE. THE RADIO IS DEVICE THAT BROADCAST MUSIC AND EMIT RADIO-PHONIC SIGNAL THAT ARE NOT HARMFUL TO HUMAN.

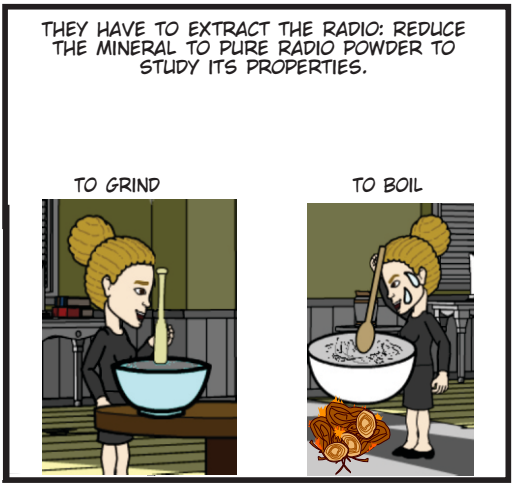
WE NEED TO ISOLATE IT IN ORDER TO PROVE IT EXISTENCE.

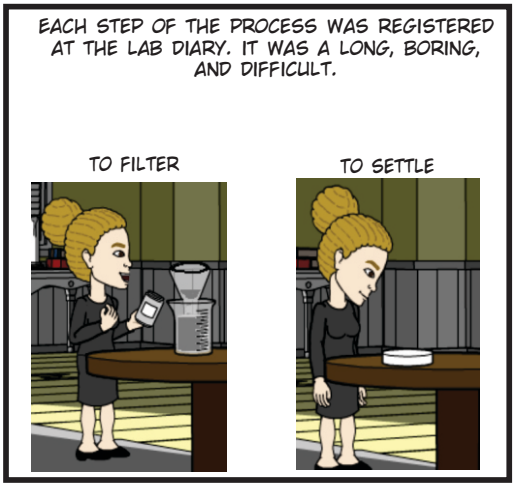
DUE TO THE IMPORTANCE OF THIS RESEARCH I DECIDE TO ABANDON MY RESEARCH WITH CRYSTAL TO FOLLOW YOU.

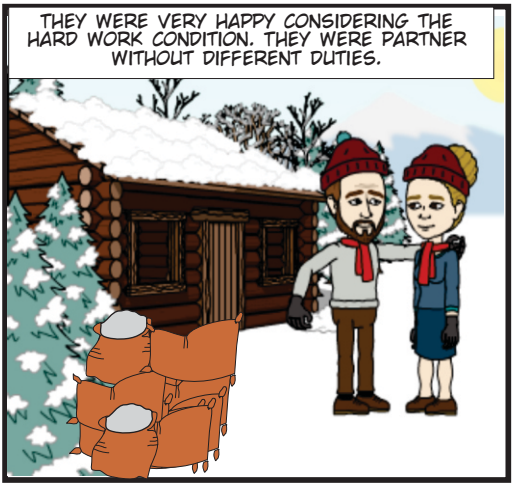
CONSIDERING THAT POLONIUM AND RADIO WAS NOT OBSERVED UP TO NOW, IT IS BECAUSE THEY PRESENT IN VERY LOW QUANTITIES. SO, WE ARE GOING TO NEED TONS OF URANINITE IN ORDER TO ISOLATE A LITTLE QUANTITY OF RADIO.

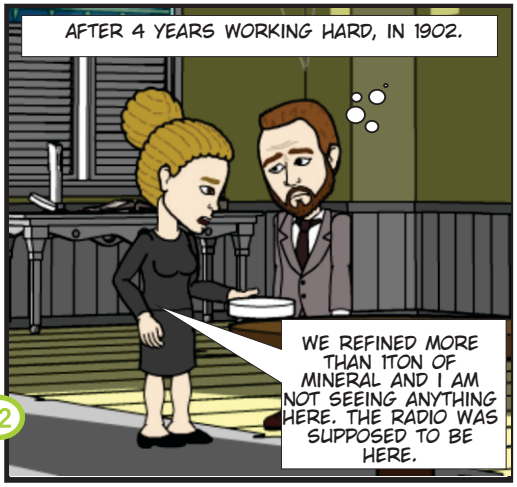

I OBTAINED THE RESIDUES OF URANINITE FROM AN AUSTRIA FACTORY WHICH EXTRACTS URANIUM.
YEAH!!!!
WE ARE GOING TO NEED ANOTHER PLACE TO DEPOSIT SEVERAL TONS OF URANINITE IN ORDER TO ISOLATE THE RADIO.
WE HAVE NO MONEY TO RENT OR BUY A PLACE TO CARRY THIS WORK.
WOW
I HAVE GOT A PERMISSION TO USE THE ABANDONED DEPOSIT AT PHYSICAL SCHOOL. WE CAN DO THE RESEARCH THERE.
I NEED TO BEGIN FROM THE VERY BEGIN. I HAVE NO RESOURCE AND ALMOST NO DEVICES.
I WILL BE WITH YOU.
THIS IS THE PLACE. LET'S GET IN.
THIS PLACE IS HORRIBLE. THE ROOF IS LEAKING.
IT DOES NOT MATTER. I WILL BE FREE HERE TO DO MY EXPERIMENTS.


THE RESIDUES OF URANINITE WERE DELIVERED TO THEM AND THEY HAD A LOT OF WORK TO DO.

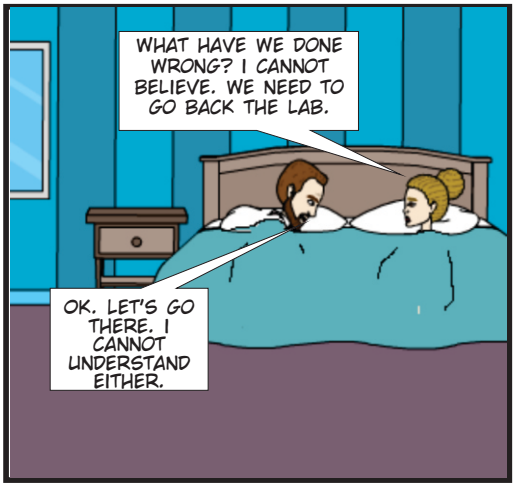

THEY HAVE TO EXTRACT THE RADIO: REDUCE THE MINERAL TO PURE RADIO POWDER TO STUDY ITS PROPERTIES.
TO GRIND
TO BOIL

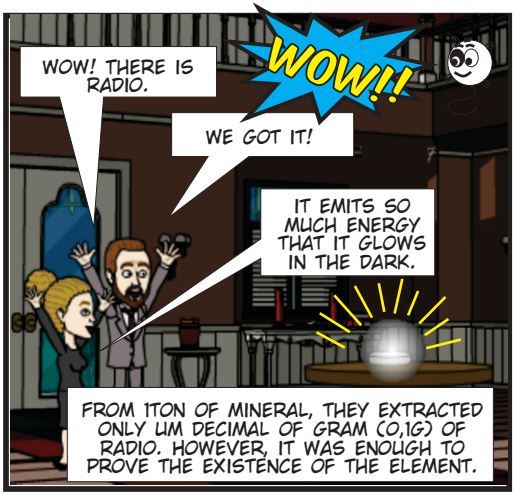

EACH STEP OF THE PROCESS WAS REGISTERED AT THE LAB DIARY. IT WAS A LONG, BORING, AND DIFFICULT.
TO FILTER
TO SETTLE

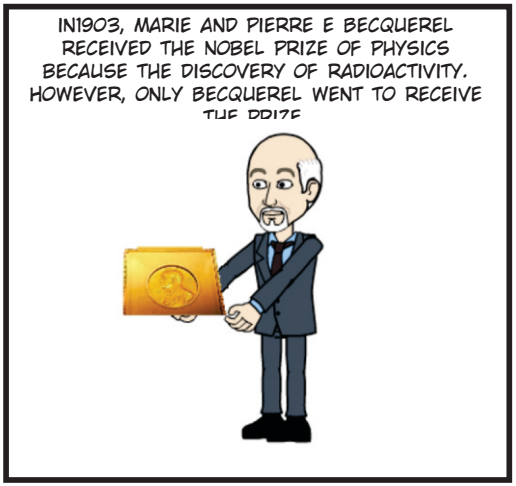

THEY WERE VERY HAPPY CONSIDERING THE HARD WORK CONDITION. THEY WERE PARTNER WITHOUT DIFFERENT DUTIES.

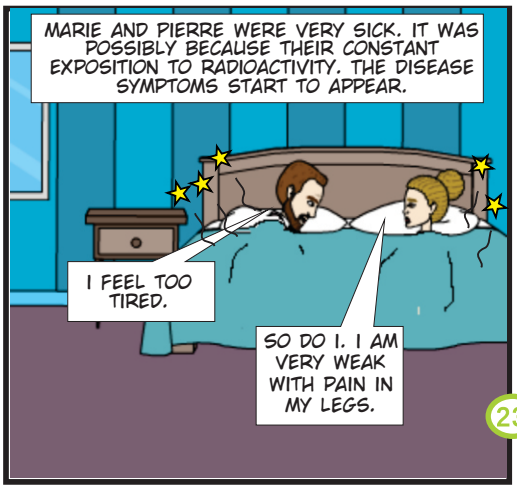

AFTER 4 YEARS WORKING HARD, IN 1902.
WE REFINED MORE THAN 1TON OF MINERAL AND I AM NOT SEEING ANYTHING HERE. THE RADIO WAS SUPPOSED TO BE HERE.

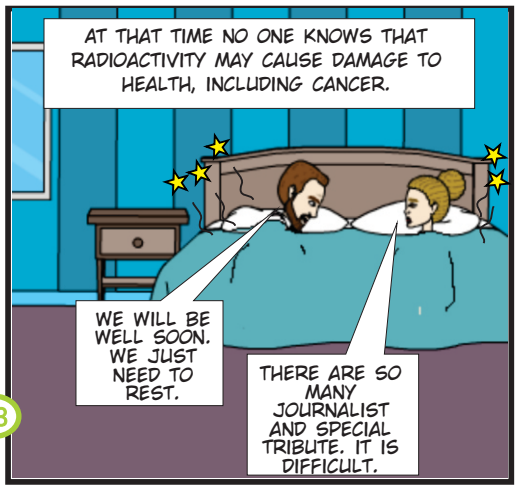

WE ARE TIRED. LET'S GO HOME. WE NEED TO REST.

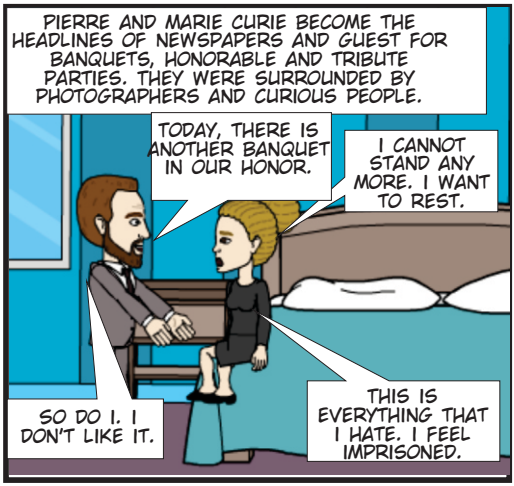

WHAT HAVE WE DONE WRONG? I CANNOT BELIEVE. WE NEED TO GO BACK THE LAB.
OK. LET'S GO THERE. I CANNOT UNDERSTAND EITHER.

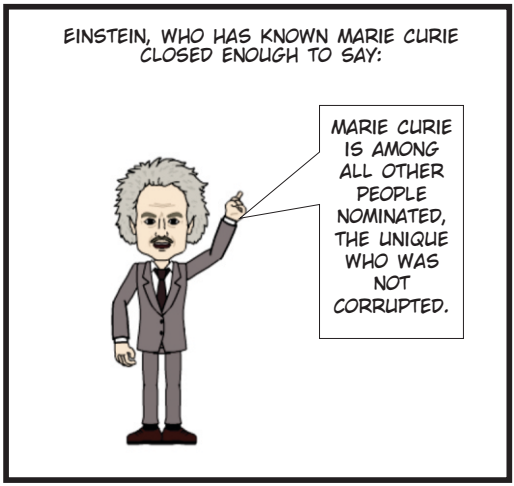

WOW! THERE IS RADIO.
WOW!!
WE GOT IT!
IT EMITS SO MUCH ENERGY THAT IT GLOWS IN THE DARK.
FROM 1TON OF MINERAL, THEY EXTRACTED ONLY UM DECIMAL OF GRAM (0,1G) OF RADIO. HOWEVER, IT WAS ENOUGH TO PROVE THE EXISTENCE OF THE ELEMENT.

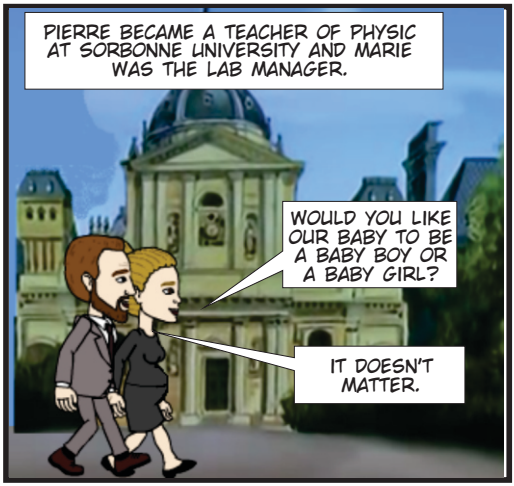

IN1903, MARIE AND PIERRE E BECQUEREL RECEIVED THE NOBEL PRIZE OF PHYSICS BECAUSE THE DISCOVERY OF RADIOACTIVITY. HOWEVER, ONLY BECQUEREL WENT TO RECEIVE


MARIE AND PIERRE WERE VERY SICK. IT WAS POSSIBLY BECAUSE THEIR CONSTANT EXPOSITION TO RADIOACTIVITY. THE DISEASE SYMPTOMS START TO APPEAR.
I FEEL TOO TIRED.
SO DO I. I AM VERY WEAK WITH PAIN IN MY LEGS.

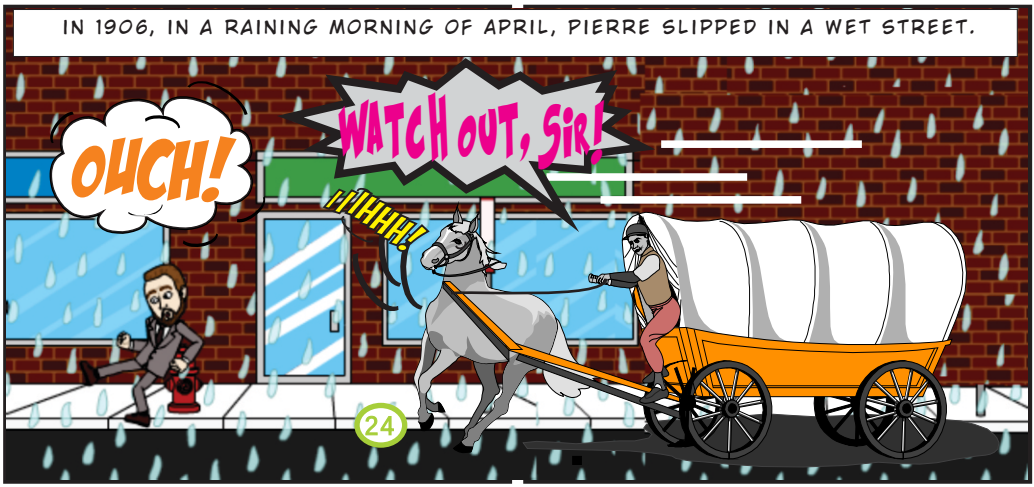

AT THAT TIME NO ONE KNOWS THAT RADIOACTIVITY MAY CAUSE DAMAGE TO HEALTH, INCLUDING CANCER.
WE WILL BE WELL SOON. WE JUST NEED TO REST.
THERE ARE SO MANY JOURNALIST AND SPECIAL TRIBUTE. IT IS DIFFICULT.

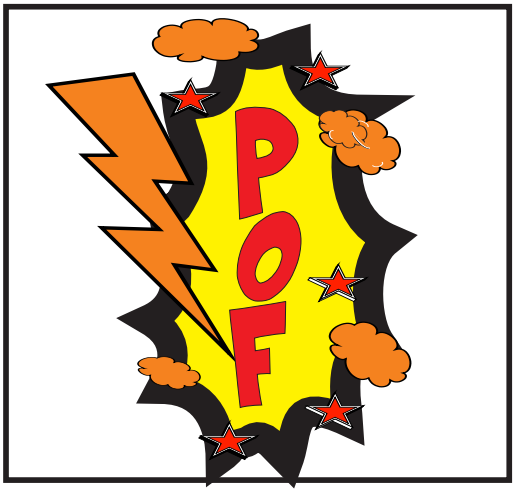

PIERRE AND MARIE CURIE BECOME THE HEADLINES OF NEWSPAPERS AND GUEST FOR BANQUETS, HONORABLE AND TRIBUTE PARTIES. THEY WERE SURROUNDED BY PHOTOGRAPHERS AND CURIOUS PEOPLE.
TODAY, THERE IS ANOTHER BANQUET IN OUR HONOR.
I CANNOT STAND ANY MORE. I WANT TO REST.
SO DO I. I DON'T LIKE IT.
THIS IS EVERYTHING THAT I HATE. I FEEL IMPRISONED.

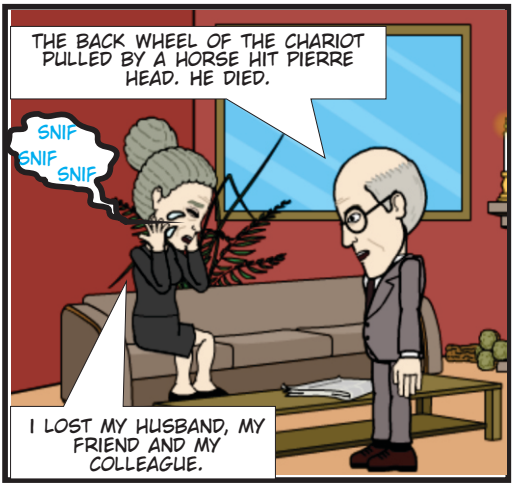

EINSTEIN, WHO HAS KNOWN MARIE CURIE CLOSED ENOUGH TO SAY:
MARIE CURIE IS AMONG ALL OTHER PEOPLE NOMINATED, THE UNIQUE WHO WAS NOT CORRUPTED.

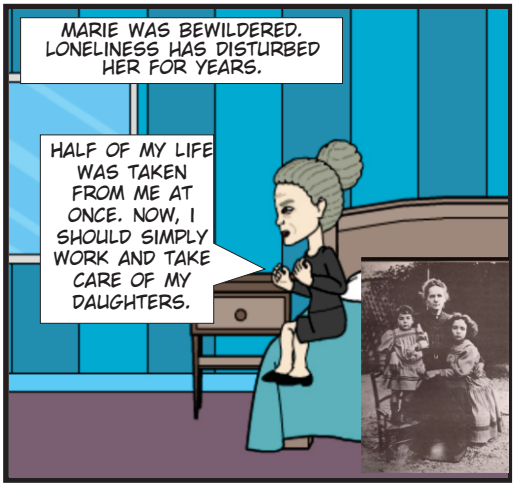

PIERRE BECAME A TEACHER OF PHYSIC AT SORBONNE UNIVERSITY AND MARIE WAS THE LAB MANAGER.
WOULD YOU LIKE OUR BABY TO BE A BABY BOY OR A BABY GIRL?
IT DOESN'T MATTER.


IN 1905 EVE WAS BORN. MARIE WAS A DEDICATED MOTHER.

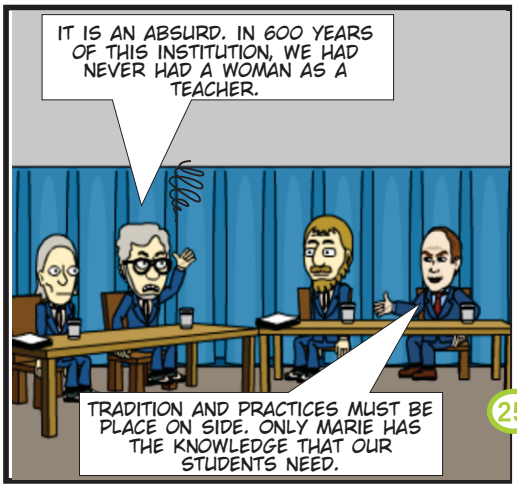

IN 1906, IN A RAINING MORNING OF APRIL, PIERRE SLIPPED IN A WET STREET.
OUCH!
WATCH OUT, SIR!
!!!HHH!
24

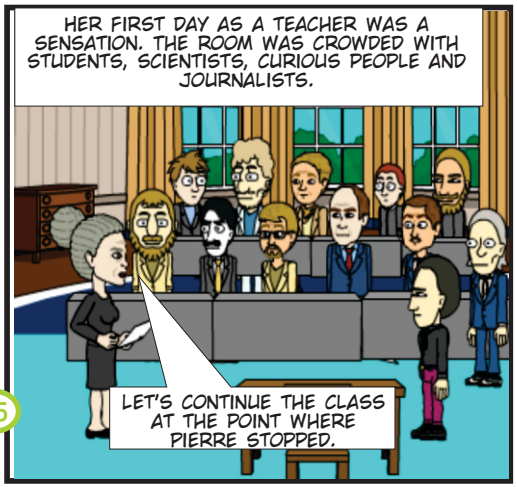

POF


THE BACK WHEEL OF THE CHARIOT PULLED BY A HORSE HIT PIERRE HEAD. HE DIED.
SNIF
SNIF
SNIF
I LOST MY HUSBAND, MY FRIEND AND MY COLLEAGUE.


MARIE WAS BEWILDERED. LONELINESS HAS DISTURBED HER FOR YEARS.
HALF OF MY LIFE WAS TAKEN FROM ME AT ONCE. NOW, I SHOULD SIMPLY WORK AND TAKE CARE OF MY DAUGHTERS.


WHILE IN SORBONNE...
WE MUST DECIDE WHO IS GOING TO REPLACE PIERRE TO GIVE CLASSES.
THERE IS ONLY ONE PERSON GOOD ENOUGH TO REPLACE HIM. MARIE CURIE.


IT IS AN ABSURD. IN 600 YEARS OF THIS INSTITUTION, WE HAD NEVER HAD A WOMAN AS A TEACHER.
TRADITION AND PRACTICES MUST BE PLACE ON SIDE. ONLY MARIE HAS THE KNOWLEDGE THAT OUR STUDENTS NEED.


HER FIRST DAY AS A TEACHER WAS A SENSATION. THE ROOM WAS CROWDED WITH STUDENTS, SCIENTISTS, CURIOUS PEOPLE AND JOURNALISTS.
LET'S CONTINUE THE CLASS AT THE POINT WHERE PIERRE STOPPED.

IN THE FOLLOWING DAY, ON NOVEMBER 6TH OF 1906, THE NEWSPAPER "LE JOURNAL" PUBLISHED:

le journal

THE DAY OF TODAY THERE WAS A CELEBRATION OF THE FEMINISM VICTORY. A WOMAN WAS ALLOWED TO TEACH GRADUATE STUDENTS OF ANY GENDER AT A COURSE IN A UNIVERSITY. WHERE WILL BE SITUATED THE ALLEGED SUPERIORITY OF MEN? THE TRUTH, IT IS COMING A DAY WHEN WOMEN WILL BE SEEN AS HUMAN-BEING.

OTHER RESEARCHES WERE CONTINUING TO CARRY ON. INCLUDING THE POSSIBILITY OF RADIO HELPS THE TREATMENT CANCER DISEASE.

THIS DISCOVERY LED MARIE CURIE TO BE EVEN MORE FAMOUS.

THE NEW ELEMENT RADIO BECOMES TO BE USED IN SEVERAL PRODUCTS:
FACIAL TREATMENT; CREAM FOR ELIMINATING FACIAL LINES AND PIMPLES; SHAMPOOS; SALTS FOR BATHING AND TOOTH PASTE.

SPARKLING WITH RADON GAS.

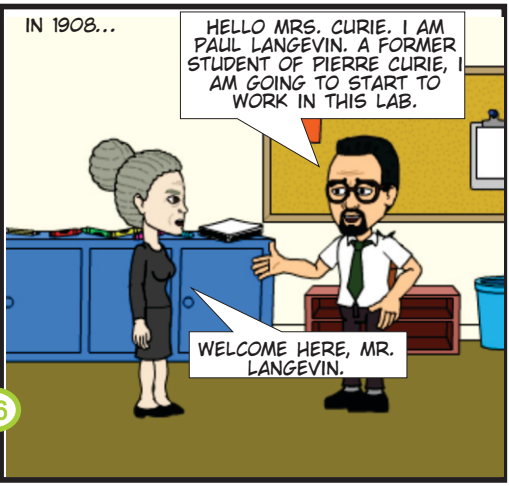
MAKE-UP POWDER WITH RADIO

THIS WAS THE HEYDAY OF RADIO WHICH ONLY ENDED AROUND 1927 WHEN IT BECOME PROVED THAT RADIATION CAN KILL THE CELLS AND CAUSE CANCER.

BY SEEING THIS SYMBOL, BE AWARE. THERE IS RADIOACTIVE MATERIAL AND IT IS NOT SUPPOSED TO BE HANDLED DUE TO THE RISK OF RADIATION LEAKAGE.

HOWEVER, THE SAME RADIO THAT CAN KILL CAN BE ALSO USED TO CANCER THERAPY. THE RADIO THERAPY IS USED NOWADAYS TO ELIMINATE THE CANCER-CELLS. IT HAS ALREADY SAVED AND EXTENDED MANY HUMAN LIVES.

IN 1908...



THEY STARTED TO GET IN TOUCH FREQUENTLY AND HAVING SEVERAL SCIENTIFIC DIALOGUES. THEY SOON FELL IN LOVE TO EACH OTHER.

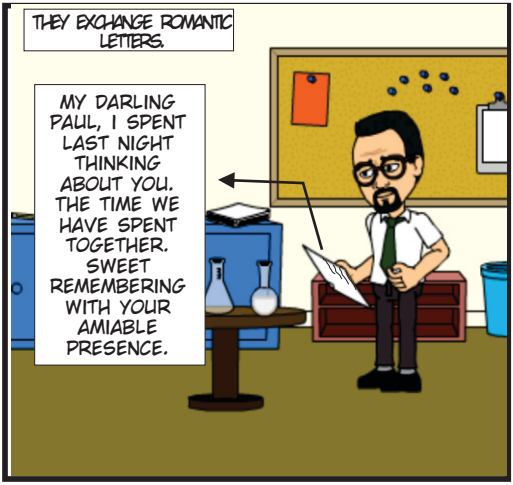
THE BEGIN HAVING A RELATIONSHIP IN 1908.

OUR PROBLEM IS THAT YOU ARE A MARRIED MAN.

MY WIFE AND I ARE NOT GETTING ALONG WELL.

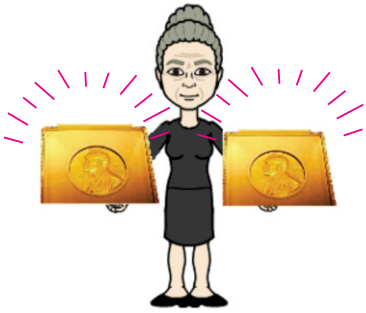
THEY EXCHANGE ROMANTIC LETTERS.

MY DARLING PAUL, I SPENT LAST NIGHT THINKING ABOUT YOU. THE TIME WE HAVE SPENT TOGETHER. SWEET REMEMBERING WITH YOUR AMIABLE PRESENCE.



IN 1911 MARIE CURIE WAS AWARDED BY THE NOBEL PRIZE, AT THIS TIME FOR CHEMISTRY FOR THE DISCOVERY OF THE TWO NEW CHEMICAL ELEMENTS: RADIO AND POLONIUM.

MARIE CURIE WAS:
- THE FIRST WOMAN TO TEACH AT SORBONNE FRENCH UNIVERSITY;
- THE FIRST WOMAN TO RECEIVE THE NOBEL PRIZE
- THE FIRST PERSON TO RECEIVE TWO NOBEL PRIZES.



MARIE CURIE BECAME THE ROLE-MODEL TO MANY OTHER WOMEN. SHE HAS SHOWN THAT WOMEN CAN BE EFFICIENT WITHOUT ABANDON THEIR FAMILY. SHE OPENED NEW POSSIBILITIES TO ALL OTHERS WOMEN.

JUST AFTER RECEIVING THE SECOND NOBEL PRIZE, HER LOVE LETTERS WAS PUBLISHED BY THE NEWSPAPERS.

MARIE CURIE KEEPS A RELATIONSHIP WITH A MARRIED MAN.

MY FEELINGS WERE EXPOSED TO THE PUBLIC.

I WILL RETURN TO MY FAMILY. THIS IS THE BEST I CAN DO TO INHIBIT THE SCANDAL.

I LOST MY REPUTATION. MY NAME IS INFAMOUS ALL OVER EUROPE IN ALL TABLOIDS.

SNIF SNIF SNIF SNIF

IN 1912 AND 1913 MARIE CURIE WENT TO THE HOSPITAL FOR TREATING A SERIES OF DISEASES, INCLUDING RENAL DISEASE SHE MIGHT HAVE ACQUIRED BECAUSE OF RADIATION. WHEN SHE GOT BETTER SHE DEDICATED TO RADIO STUDIES.

IN 1914 THE FIRST WORLD WAR BEGAN.

MARIE WAS VERY PATRIOTIC.

I AM GOING TO USE SCIENCE AND TO THINK ABOUT THE NATIONAL INTEREST.

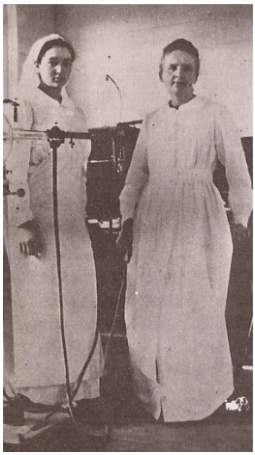
I WILL ASSEMBLE A MOBILE UNIT TO HELP TREAT THE SOLDIERS WOUNDED IN THE WAR.

WE WILL BE ABLE TO SEE THE BOMB FRAGMENTS INSIDE YOUR BODY.

IS IT GOING TO HURT?

ABSOLUTELY, IT IS EXACTLY THE SAME AS TAKING A PICTURE.

SHE TRAINED NURSES TO USE THE MOBILE X-RAY MACHINE. ONE OF THE NURSES WAS HER DAUGHTER IRENE, AT THE AGE OF 18. THE PARTNERSHIP BETWEEN MOTHER AND DAUGHTER WILL LAST FOR ALL MARIE CURIE LIFE.



ALTOGETHER, MARIE CREATED 20 MOBILE UNITS ("LITTLE CURIES") TO THE END OF THE WAR. MORE THAN ONE MILLION WOUNDED SOLDIERS RECEIVED TREATMENT.

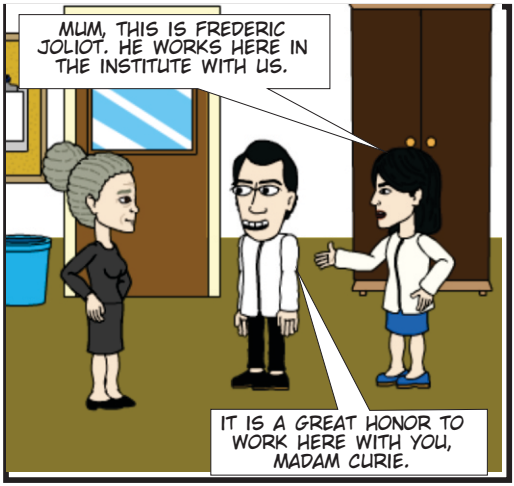
YOU DON'T MIND OF NOT FEEDING WELL AND NEITHER HAVING A RIGHT PLACE FOR SLEEPING?

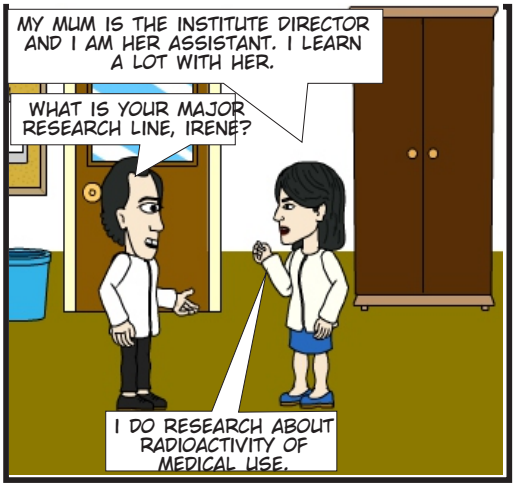
I AM GLAD FOR BEING HELPFUL.

THE ONLY THING THAT LEFT MARIE AWAY FROM HER DUTIES WAS HER UNEXPLAINED DISEASE.

AT THE END OF THE WAR, IN 1918, SHE BECAME AGAIN TO BE VERY WELL KNOWN. THE AFFAIR WITH PAUL LAVENGIN WAS ALREADY FORGOTTEN.

IN 1918 WAS INAUGURATED THE INSTITUTE OF RADIO IN PARIS. WHICH BECOME CALLED INSTITUTE CURIE NOWADAYS, WHERE THEY DEDICATE THE STUDY OF ONCOLOGY AND THE MEDICAL EFFECTS OF RADIO.

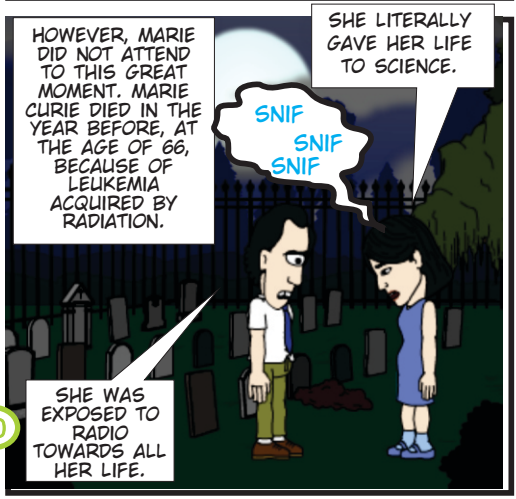




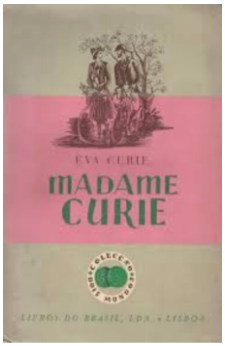
IRENE CURIE AND FRÉDÉRIC JOLIOT GOT MARRIED IN 1926 AND WORKED TOGETHER, JUST LIKE MARIE AND PIERRE.

IN 1932 WAS INAUGURATED THE RADIO INSTITUTE IN WARSAW. NOWADAYS IT IS NAMED AFTER INSTITUTE OF ONCOLOGY MARIA SKLODOWSKA-CURIE.

IN 1933, THE COUPLE JOLIOT & CURIE DISCOVERS THE ARTIFICIAL RADIOACTIVITY AND TOGETHER RECEIVED IN 1935, THE NOBEL PRIZE FOR THE SYNTHESES OF THE NEW RADIOACTIVE ELEMENTS.



THE OTHER DAUGHTER, EVE, TOOK CARE OF MARIE DURING HER DISEASE AND WROTE A LOVELY MEMOIR: A BOOK "MADAM CURIE". IT BECOME THE BEST SELLER FROM WHICH A MOVIE AS MADE IN 1943.



SOME TIME LATER IRENE AND JOLIOT DAUGHTER GOT MARRIED WITH PAUL LANGEVIN GRANDSON.

MARIE CURIE'S WORKS RESULT IN THE TECHNOLOGY PROGRESS OF NUCLEAR PHYSICS AND NUCLEAR ENERGY.

BUT, UNFORTUNATELY, IT ALSO TURNS POSSIBLE THE INVENTION OF THE ATOMIC BOMB.

PIERRE CURIE, IN 1905, WAS OPTIMIST:

THE END

EXPERIMENT 1)
TITLE: Very little matter

Marie and Pierre Curie extracted only 0.1 tenth of a gram (0.1g) of Radio from one ton of mineral. How is possible to measure quantities so small with scale not so precise?

OBJECTIVE: to show that certain measures can be obtained via indirect manner; to show that it is necessary to formulate hypothesis to do certain measurements.

MATERIAL: a balance scale, it's the most simple kind of scale, confetti (it can be obtained with a paper punch, clips, 1g weight or gram mass standardize set (or any object which has the same weight).

PROCEDURE:

1. Place the 1g weight in one side of the weighing pan.
2. On the other side place as much clips are necessary to balance the scale lever.
3. Complete: 1g = ____ clips.
4. Place 1 confetti on one side of the weighing pan and try determining its mass (first measure).
5. Place an amount of confetti in one side of the weighing pan and determine in clips, the mass of the amount of confetti (second measure).
6. Transfer into grams the obtained value in clips.
7. Calculate one confetti mass.
8. Duplicate twice the steps 5, 6 and 7 by using numbers of confetti multiple of ten, in order to facilitate the calculation and fill up the following table (3rd and 4th measures).
9. Place on the scale an amount of confetti without counting them previously. Calculate the approximately the number of confetti from the confetti mass set. (5th measure).

	Number of confetti	Total mass (g)	Mass of 1 confetti (g)
1st measure			
2st measure			
3st measure			
4st measure			
5st measure			

EXPERIMENT 2)

TITLE: Split the matters

Marie and Pierre Curie made the Radio extraction, this is, split the matter from mineral and reduce Radio to pure powder. To do that they grind the mineral (Uraninite), boiling, filtering, settling. In science, frequently, there is the necessity of splitting material and there is several techniques employed. Filtration, adsorption (attachment of molecule from a liquid to a solid surface), evaporation, distillation – depending on the matter that will be split.

OBJECTIVE: From the steps A, B and C will be made with a solution of methylene blue with should be prepared according to the instructions:

PREVIOUS PROCEDURE: As etapas A,B e C serão realizadas com solução de azul-de-metileno que deverá ser preparada de acordo as instruções:

MATERIAL: 25ml of Alcohol, 10mg of methylene blue (powder), 1 glass stick, 1 plastic funnel, a plastic spoon, 1 glass, 1 bottle (100ml) with tread cap and label.

PREPARING THE METHYLENE BLUE SOLUTION:

1. Place the methylene blue in the glass (the amount of a size of a match-tip).
2. Adding alcohol.
3. Agitate the substance with the glass stick.
4. Adding water up to the top of the glass and mix again.
5. Save in the bottle sealed and labeled.

STEP A: Filtration

MATERIAL: 5ml of the solution of methylene blue, 1glass, 1glass stick, 1essay test tube rack, 1 plastic funnel, 1essay test tube and 1 sheet of filter-paper.

PROCEDURE:

1. Transfer to the glass the solution of methylene blue.
2. Place the essay test tube and the funnel in the rack. (figure 1).
3. Fold the filter-paper as indicated (figure 2) and place it in the funnel.
4. Moist the filter-paper, so it will adhere to the side of funnel.
5. Insert the funnel in the essay test tube.
6. With the glass stick, shed in funnel the solution of methylene blue and by using the following technique: Hold the glass stick with the left hand and keep it leaned towards the funnel. Then drop carefully the solution over the stick, some how the solution slides on it.

RESULTS:

1. What was the color of the filtrated liquid? _____
2. What color was attached on the filter-paper? _____
3. Did you notice any solid matter stick on the filter-paper? ___

FIGURE 1

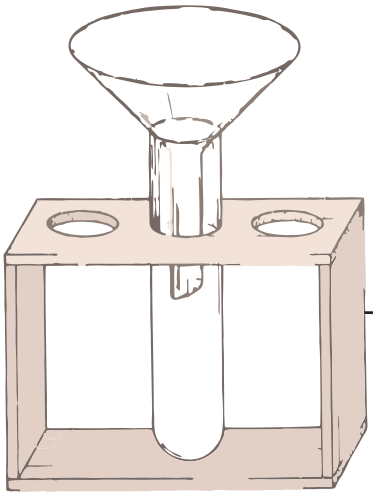
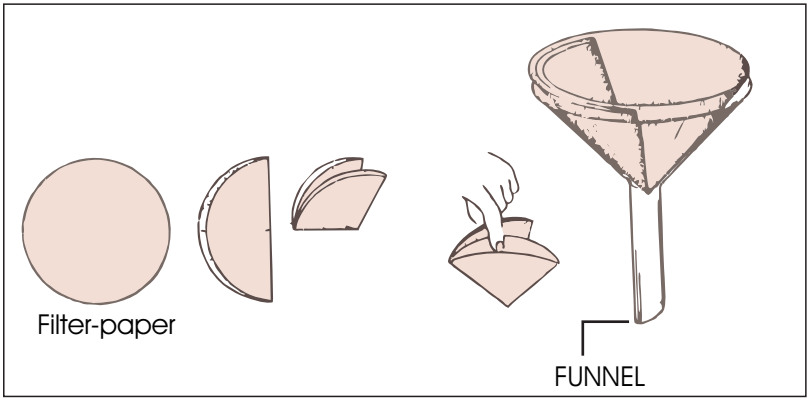


FIGURE 2



STEP B: Separation by coal Adsorption

Adsorption occurs when the particles attach to the coal surface (Adsorption is the attachment of molecule from a liquid to a solid surface).

MATERIAL: 1g of coal, (common coal in small pieces) 10ml methylene blue solution, 01 plastic spoon, 1 plastic funnel, 2 essay test tube, 1 glass, 1 glass stick, 1 essay test rack, 1filter-paper sheet.

PROCEDURE:

1. Place the methylene blue solution inside the glass.
2. Add the coal by mixing it during 2 minutes approximately.
3. Filter the mixing with the filter-paper.
4. If the filtered solution is not clear, redo the process using the same filter-paper and another essay test tube.
5. Now, redo the experiment by using ground coal.

RESULTS:

1. Formulate a hypothesis to explain item 4 result.
2. When did the adsorption occur in high level, with the coal in pieces or ground coal, why?

STEP C: Evaporation

MATERIAL: 5ml methylene blue solution, 1glass, 1 plastic funnel, 1glass stick, wood-clamper, 1essay test tube 1essay test racks, 1 oil-lamp and alcohol for burning.

PROCEDURE:

1. Place the essay test tube on the rack.
2. Place the methylene blue solution inside the clean glass and transfer this solution to the essay test tube by using the funnel and the glass-stick.
3. Light up the oil-lamp.
4. Hold the essay tube with the wood clamper by holding it on the flame.
5. Wait for the solution gets boiling and allow it to evaporate.
6. Observe the dark blue residue that settles on the bottom of the essay tube.

EXPERIMENT 3)
TITULO: Examining matters
OBJECTIVE: To show the rock aspect is related to the matters that comprises it and, also, the size, shape and arrangement of their components.

MATERIAL: magnetic, microscopy plate, tooth-pick, two sample of rocks (granite, gneiss, or any other) a piece of cloth and a hammer.

PROCEDURE:

1. Grind the rocks samples. In order to do it, wrap the rock in a piece of cloth and hammer it.
2. Gather the little pieces which are more similar in bunch. (Use the tooth-pick to handling and splitting the rock fragments).
3. Find out if different fragments are attracted by the magnetic.
4. Place the microscopy plate on the table by rubbing on it different fragments to observe if it scratches the glass.

RESULT: complete the table to show the difference between the two samples studied.

	material	Brightness	color	Hardness	Magnetic attraction
RocK 1	A				
	B				
	C				
	D				

	material	Brightness	color	Hardness	Magnetic attraction
RocK 2	A				
	B				
	C				
	D				

EXERCISES

1) What are Marie Curie main discoveries?
2) What is the importance of these discoveries?
3) What impact these discoveries caused to the world?
4) Has Marie Curie got any acknowledgement while she was alive, what were they?
5) Marie suffered discrimination for being a woman? Issue examples.
6) How are women currently discriminated?
7)What is your opinion about the use of radioactive by human-being?
8) Why is it important to recognize the symbol that indicates the presence of radioactive material?
9) How can science and society be prejudiced by prejudice?
10) What can happen if radioactive material leak in the environment?
11) In 2011, Japan was reach by a violent earthquake following a tsunami. These events caused accidents in Nuclear Japanese Plants, which raised concerns all over the world about the safety of those plants. What are the advantage and disadvantages of these plants?
12) What the difference between x-ray and radioactivity?
13) Radiography are images of the inside part of human body obtained with x-ray and largely used by medical treatment. Explain how the image is transferred to the photographic plate.
14) Try finding, in the comics, which drawing the bug-bug () appears and describe what the scientific discovery is discussed.

COLLECTION

INCREDIBLE SCIENTISTS, SENSATIONAL DISCOVERIES

- in comics -

1-NICOLAU COPÉRNICO AND THE SOLAR SYSTEM

2-HISTORY OF THE CELLULAR THEORY

3-CHARLES DARWIN AND THE THEORY OF EVOLUTION

4-GREGOR MENDEL, THE FATHER OF GENETICS

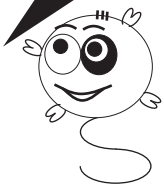
5-LUIS PASTEUR AND THE MICROBIAL THEORY

6-ARQUIMEDES, THE FIRST SCIENTIST

7-GALILEU GALILEI, THE MESSENGER OF THE STARS

8- ISSAC NEWTON AND UNIVERSAL GRAVITATION

9- VITAL BRAZIL AND THE ANTIPHYDIC SERUM



10- PETER LUND AND BRAZILIAN PALEONTOLOGY

11- EINSTEIN AND THE RELATIVITY

12- HISTORY OF THE ORIGIN OF LIFE

13- HISTORY OF DINOSAURS

14- JOHN DALTON AND ATOMIC THEORY

15- WATSON & CRICK AND THE DNA

16- MARIE CURIE AND THE RADIOACTIVITY

17- THE EVOLUTION OF SCIENTIFIC THINKING

18- OSWALDO CRUZ & CARLOS CHAGAS AND THE EPIDEMICS OF BRAZIL

19- CARLOS LINEU AND THE CLASSIFICATION OF LIVING BEINGS

20- DMITRI MENDELEEV AND THE PERIODIC TABLE

21. STEPHEN HAWKING: FROM BIG BANG TO BLACK HOLES

22. THE 5 SENSES IN THE FIELD AND IN THE CITY

23. VISIT TO THE MUSEUM

24. MARY ANNING, THE FOSSIL HUNTER