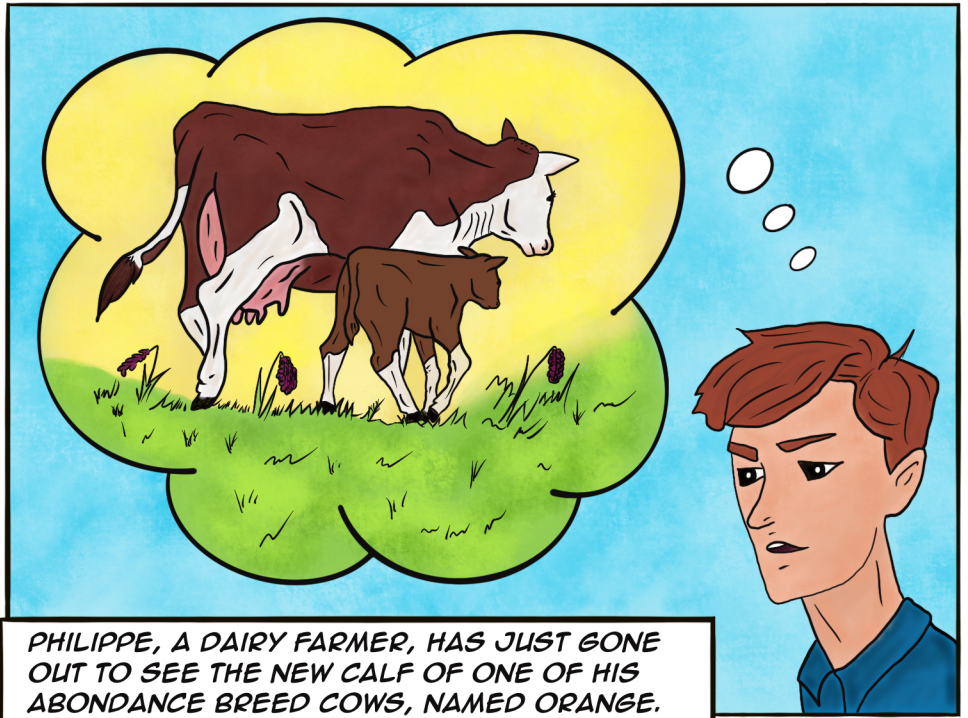


ALICIA JACQUES, GRÉGOIRE LEROY, XAVIER ROGNON, ÉTIENNE VERRIER, MICHÈLE TIXIER-BOICHARD & GWENDAL RESTOUX

USE OF CRYOPRESERVED SEMEN FROM AN ANCIENT BULL: A WAY TO MANAGE THE GENETIC DIVERSITY OF A LOCAL BREED ?



SOMEWHERE IN THE FRENCH CHABLAIS REGION...



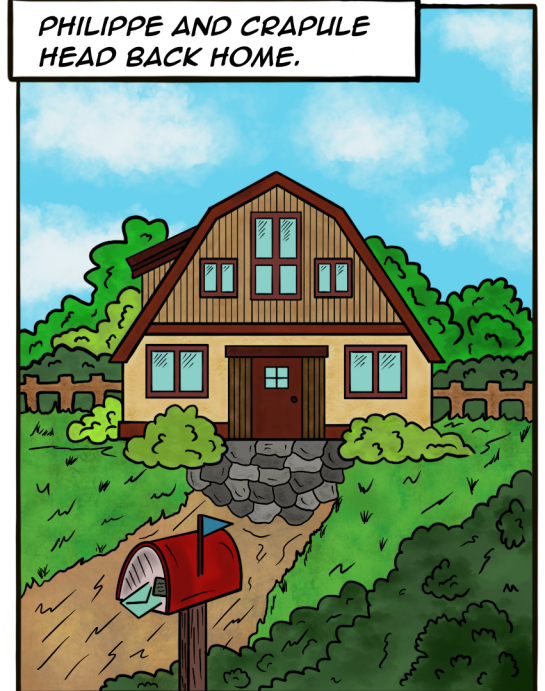
PHILIPPE, A DAIRY FARMER, HAS JUST GONE OUT TO SEE THE NEW CALF OF ONE OF HIS ABONDANCE BREED COWS, NAMED ORANGE.



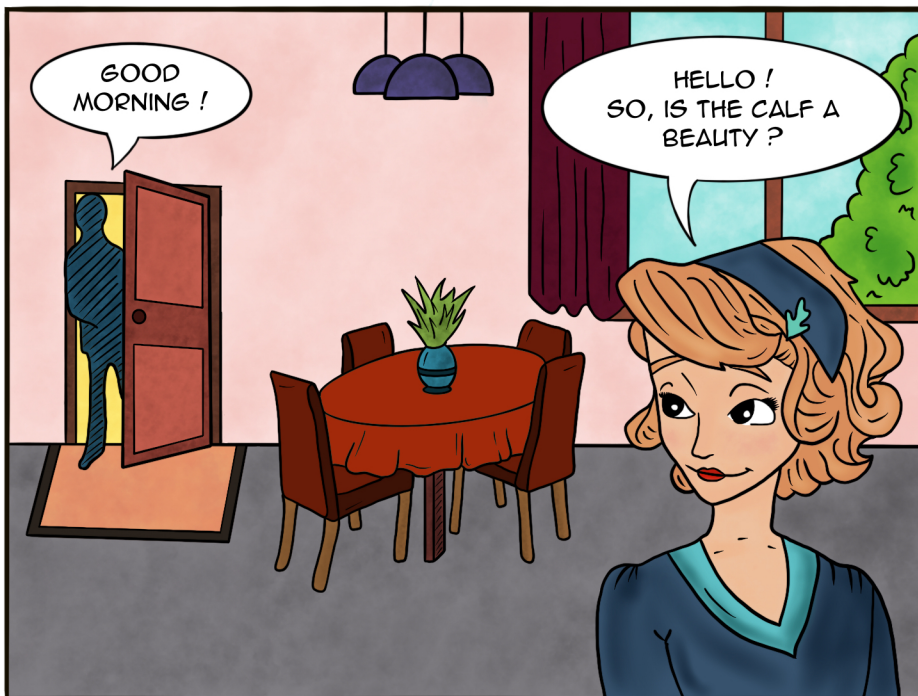
COME ON CRAPULE, LET'S GO HOME !



IT'S ABOUT TIME... I'M DREAMING OF A LONG NAP ON THE SOFA...

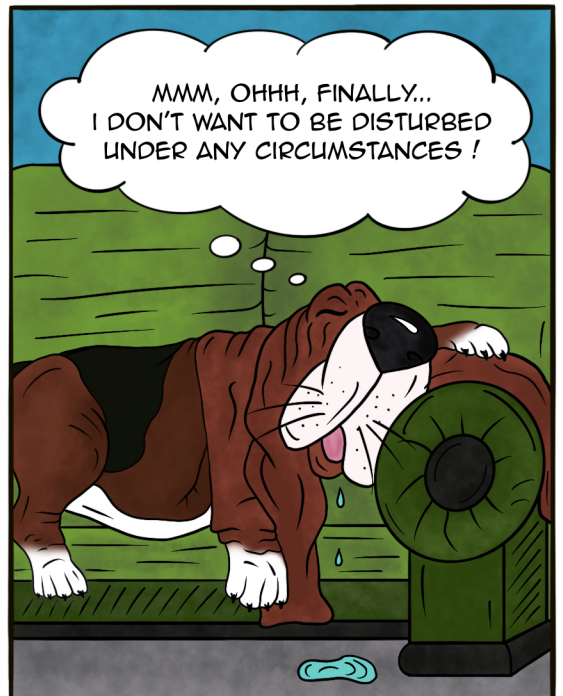


PHILIPPE AND CRAPULE HEAD BACK HOME.

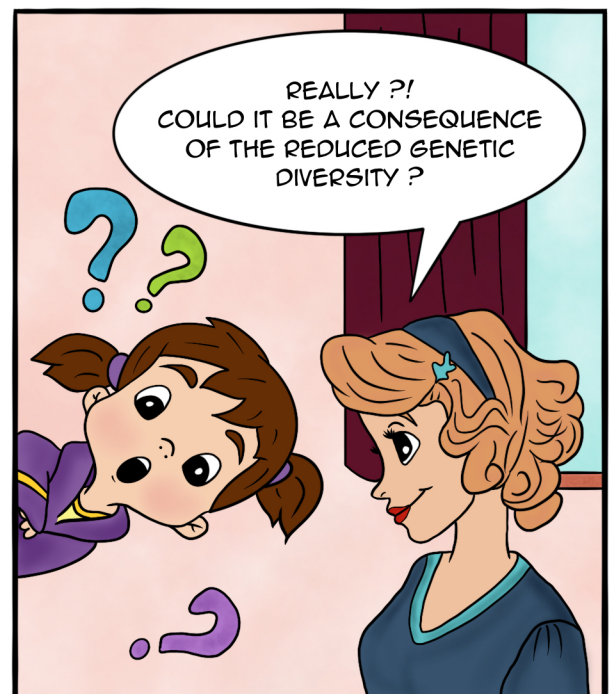
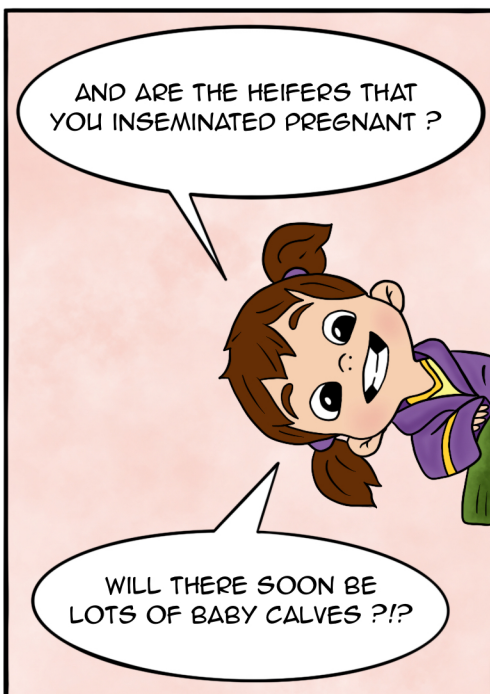
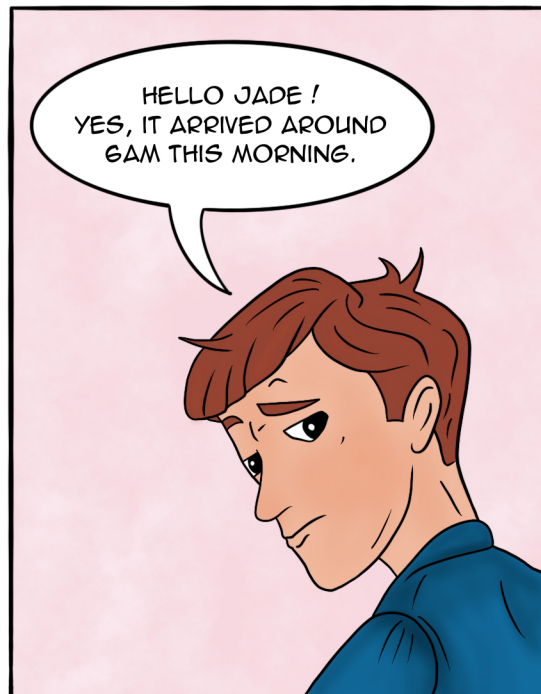
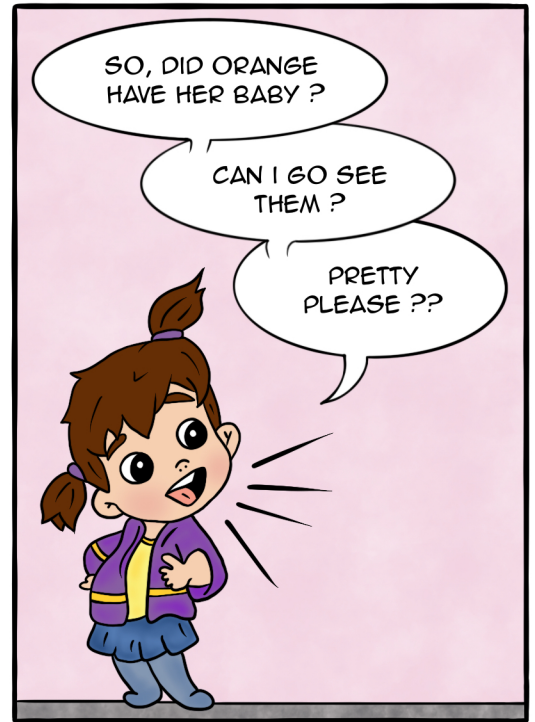


GOOD MORNING !

HELLO ! SO, IS THE CALF A BEAUTY ?

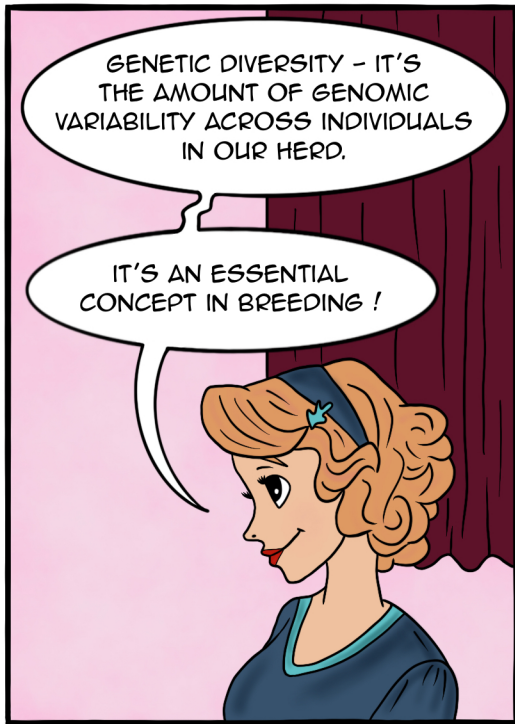


MMM, OHHH, FINALLY... I DON'T WANT TO BE DISTURBED UNDER ANY CIRCUMSTANCES !



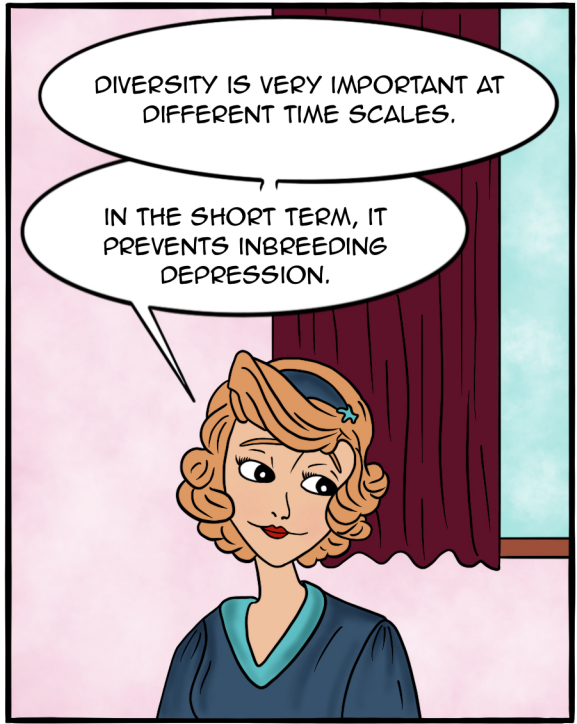


THE WHAT ?!



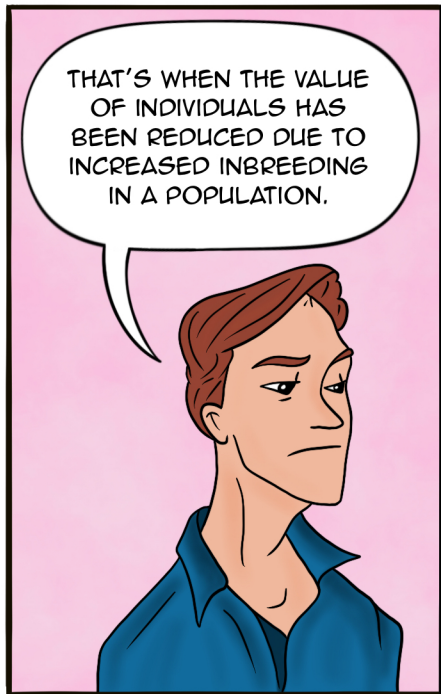
GENETIC DIVERSITY - IT'S THE AMOUNT OF GENOMIC VARIABILITY ACROSS INDIVIDUALS IN OUR HERD.

IT'S AN ESSENTIAL CONCEPT IN BREEDING !

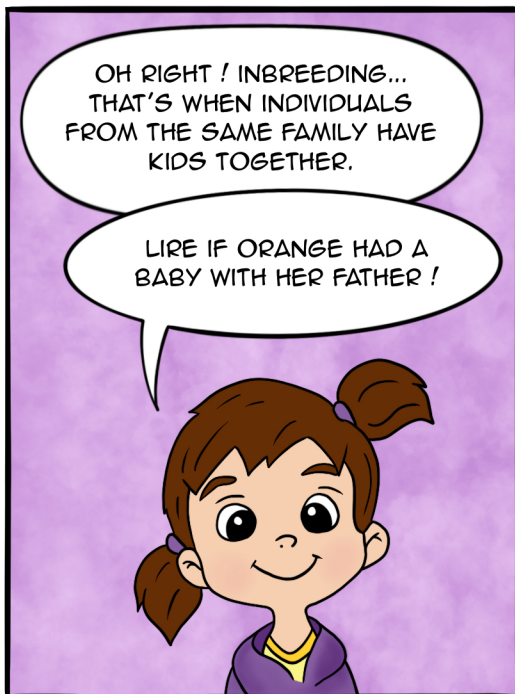


DIVERSITY IS VERY IMPORTANT AT DIFFERENT TIME SCALES.

IN THE SHORT TERM, IT PREVENTS INBREEDING DEPRESSION.



THAT'S WHEN THE VALUE OF INDIVIDUALS HAS BEEN REDUCED DUE TO INCREASED INBREEDING IN A POPULATION.

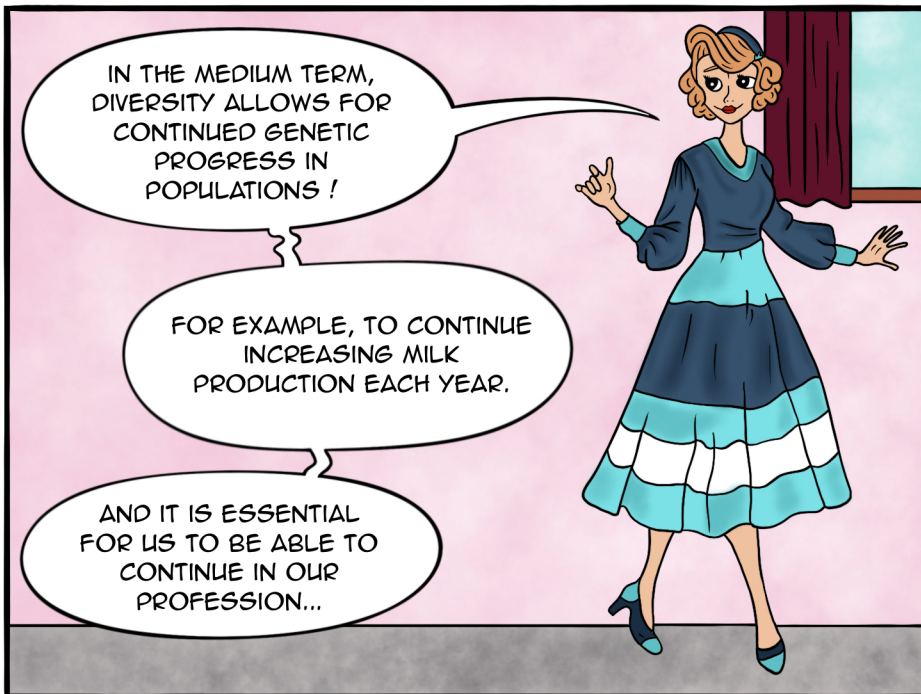


OH RIGHT ! INBREEDING... THAT'S WHEN INDIVIDUALS FROM THE SAME FAMILY HAVE KIDS TOGETHER.

LIRE IF ORANGE HAD A BABY WITH HER FATHER !



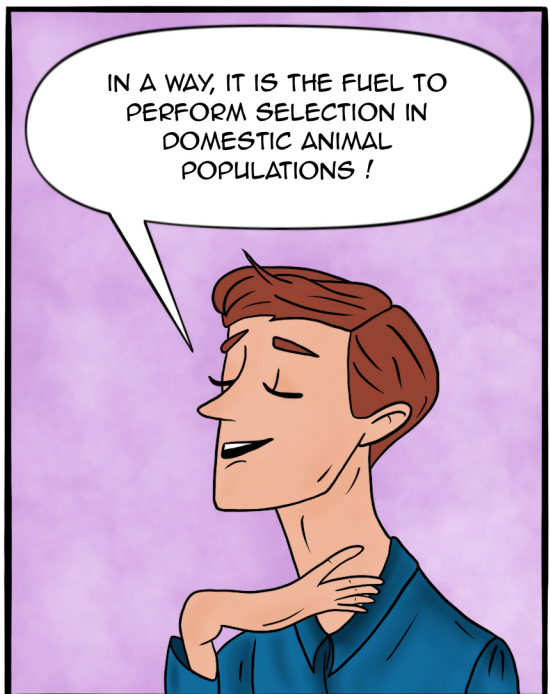
EXACTLY ! AND THAT WOULD DECREASE THE GENETIC DIVERSITY...



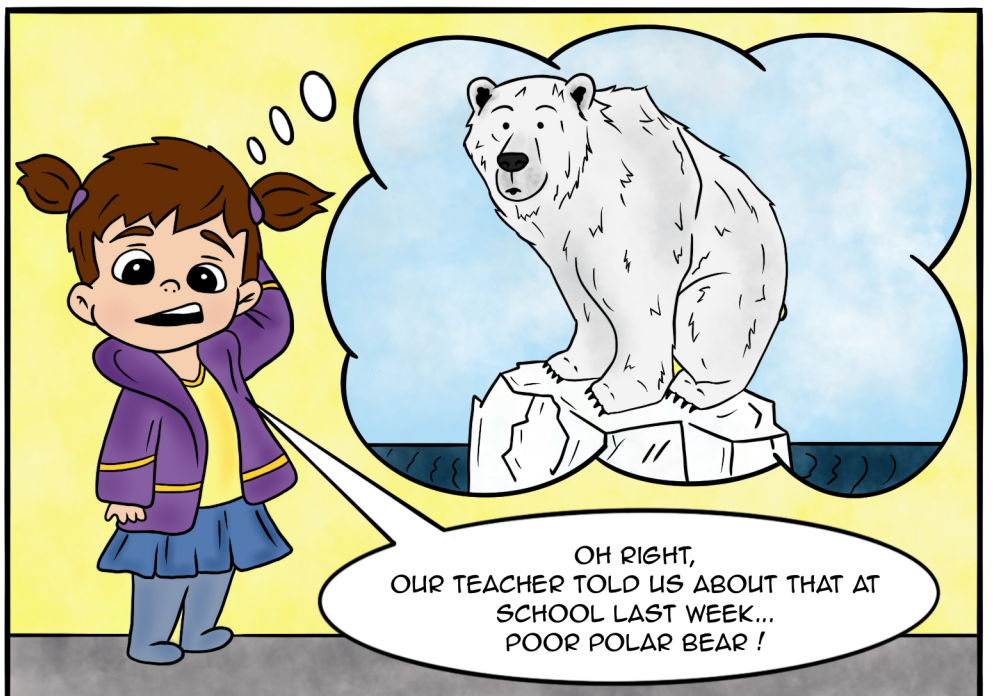
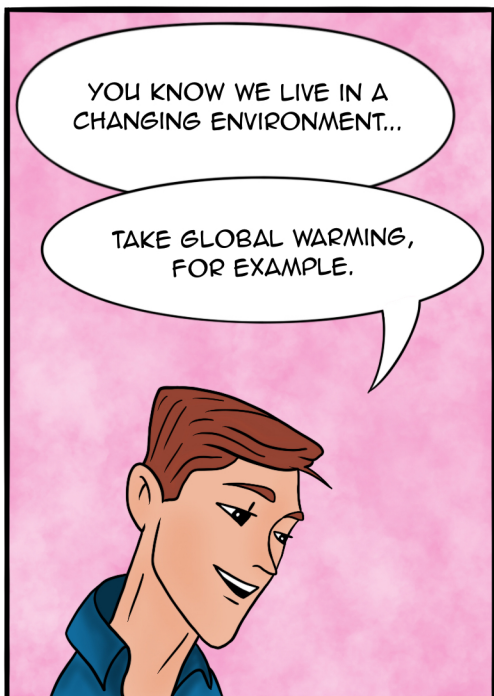
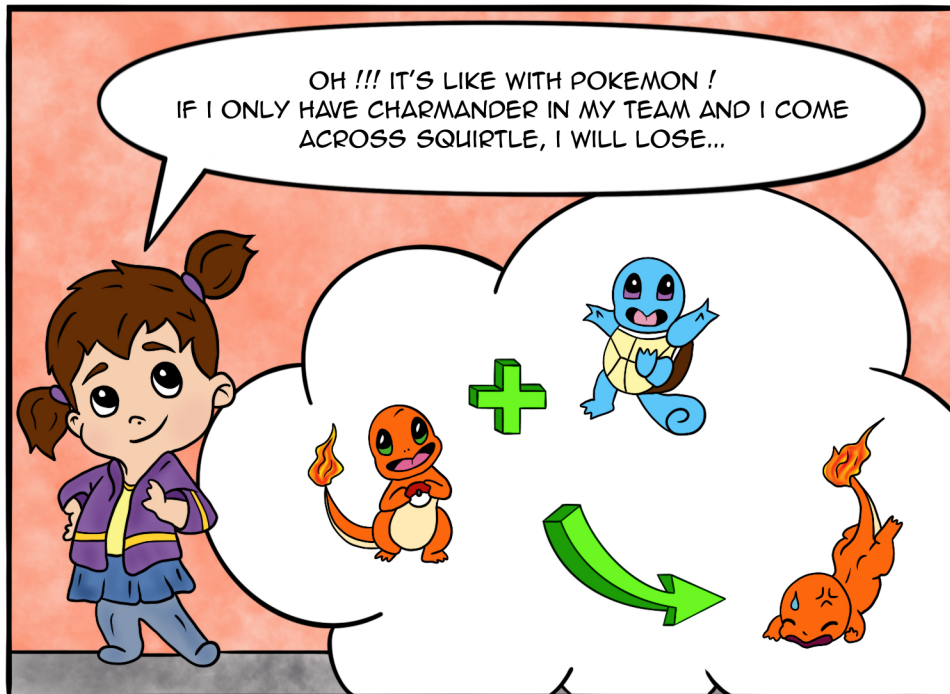
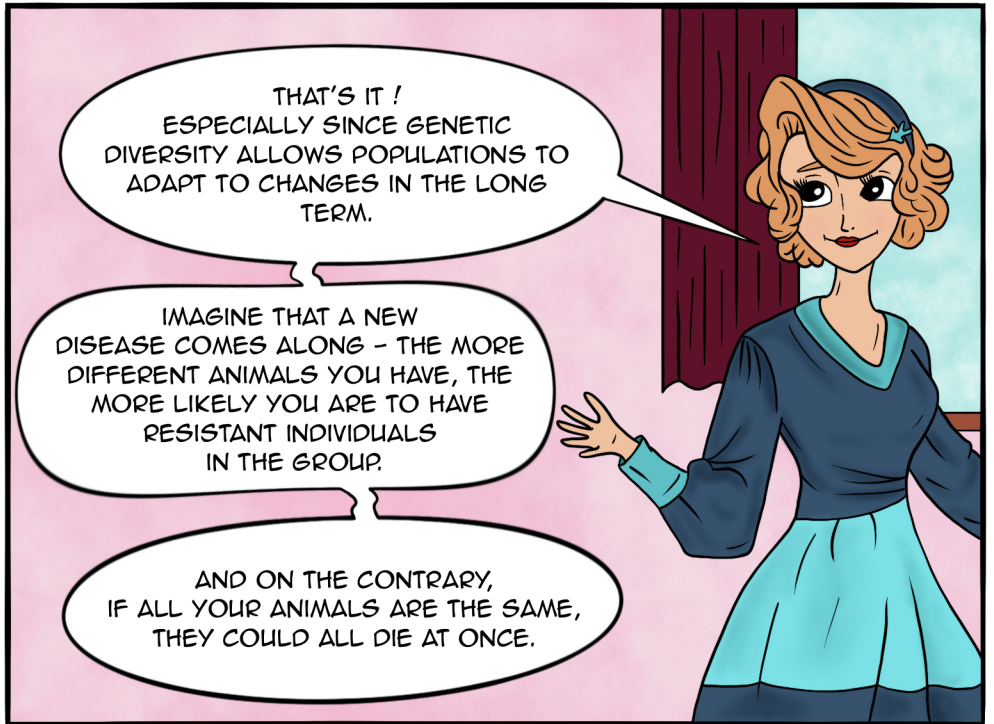
IN THE MEDIUM TERM, DIVERSITY ALLOWS FOR CONTINUED GENETIC PROGRESS IN POPULATIONS !

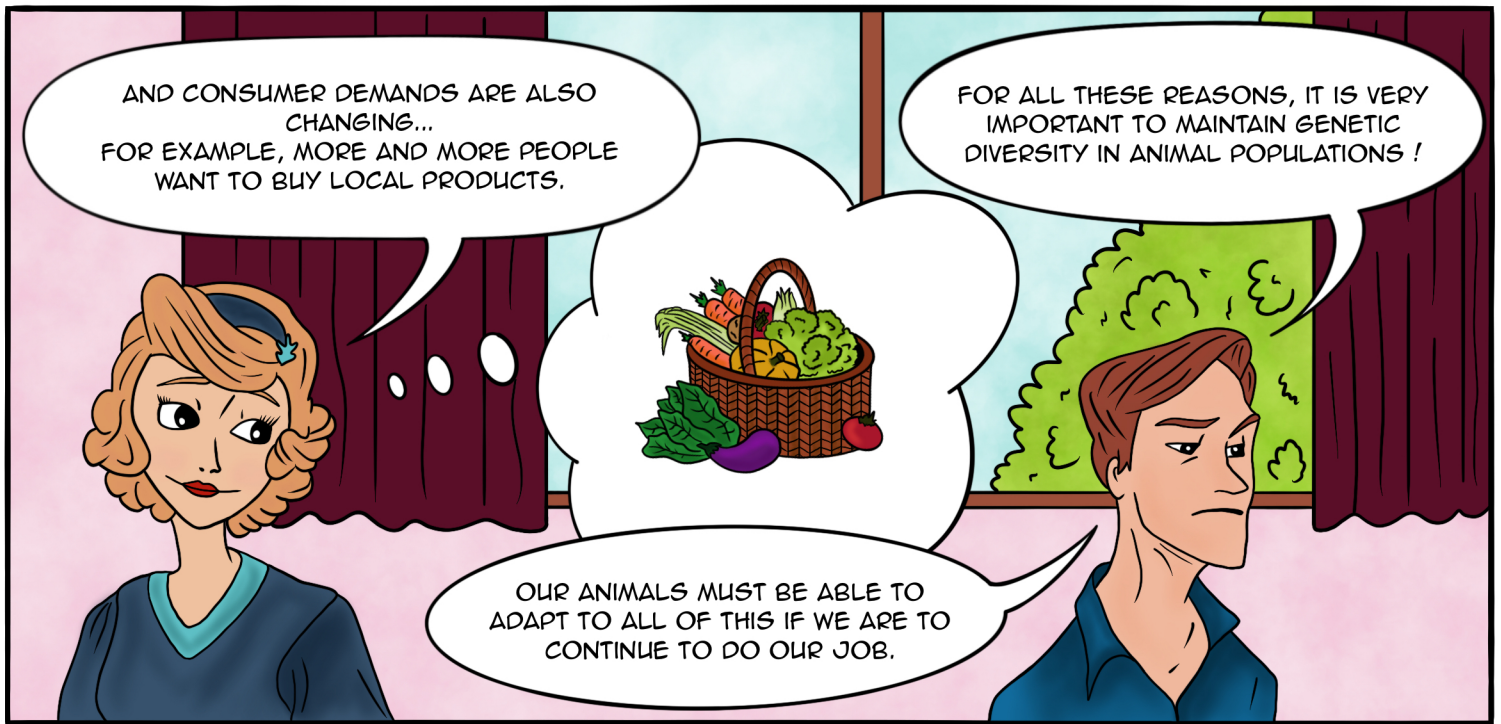
FOR EXAMPLE, TO CONTINUE INCREASING MILK PRODUCTION EACH YEAR.

AND IT IS ESSENTIAL FOR US TO BE ABLE TO CONTINUE IN OUR PROFESSION...



IN A WAY, IT IS THE FUEL TO PERFORM SELECTION IN DOMESTIC ANIMAL POPULATIONS !

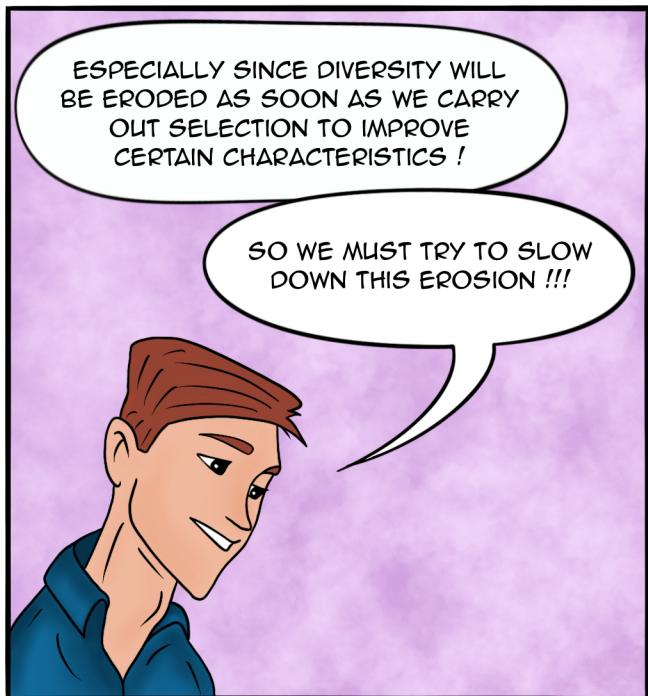




AND CONSUMER DEMANDS ARE ALSO CHANGING... FOR EXAMPLE, MORE AND MORE PEOPLE WANT TO BUY LOCAL PRODUCTS.

FOR ALL THESE REASONS, IT IS VERY IMPORTANT TO MAINTAIN GENETIC DIVERSITY IN ANIMAL POPULATIONS !

OUR ANIMALS MUST BE ABLE TO ADAPT TO ALL OF THIS IF WE ARE TO CONTINUE TO DO OUR JOB.

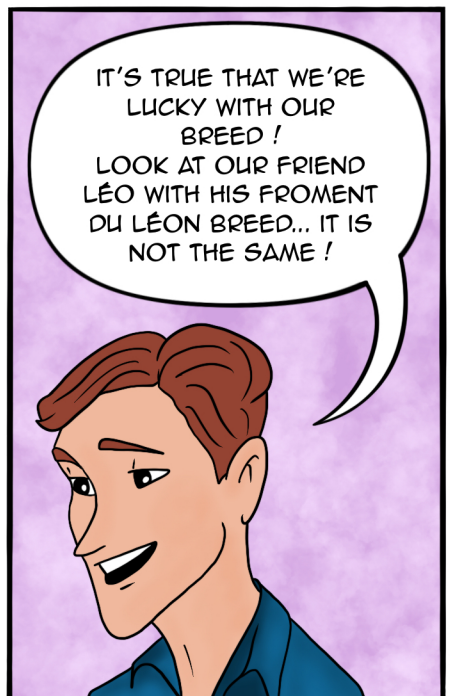


ESPECIALLY SINCE DIVERSITY WILL BE ERODED AS SOON AS WE CARRY OUT SELECTION TO IMPROVE CERTAIN CHARACTERISTICS !

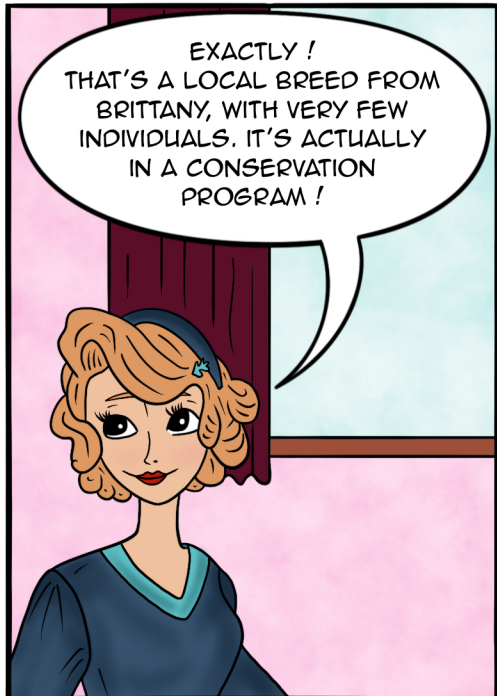
SO WE MUST TRY TO SLOW DOWN THIS EROSION !!!



AND DIVERSITY ERODES FASTER IF THE POPULATION ONLY HAS A SMALL NUMBER OF INDIVIDUALS...



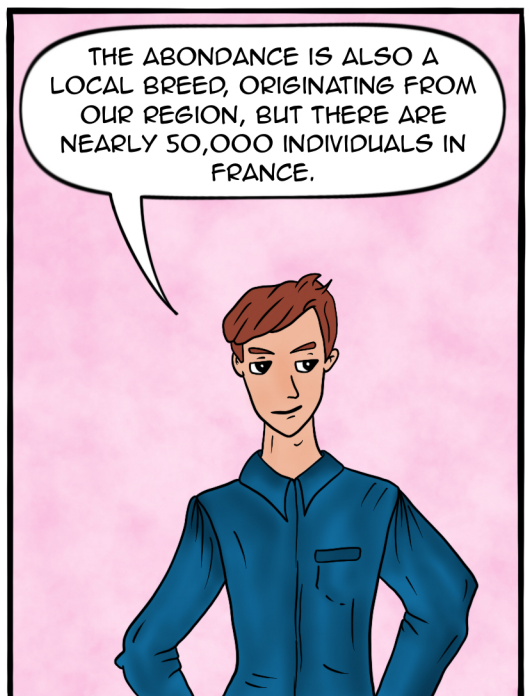
IT'S TRUE THAT WE'RE LUCKY WITH OUR BREED ! LOOK AT OUR FRIEND LÉO WITH HIS FROMENT DU LÉON BREED... IT IS NOT THE SAME !



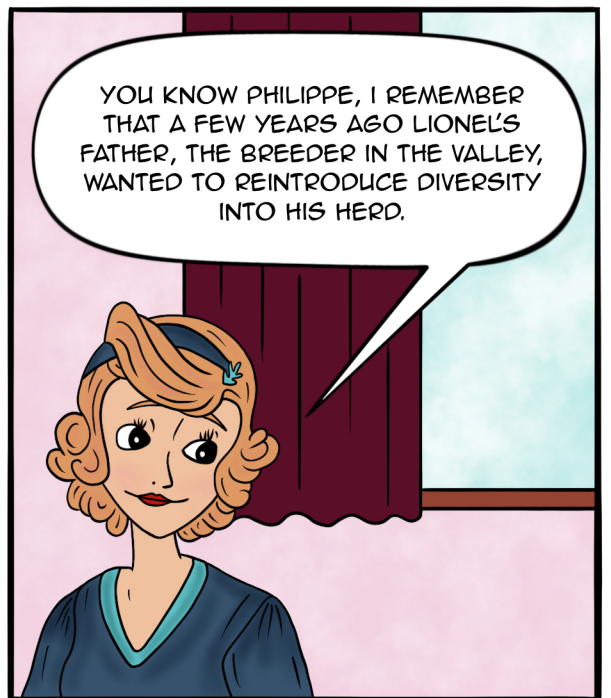
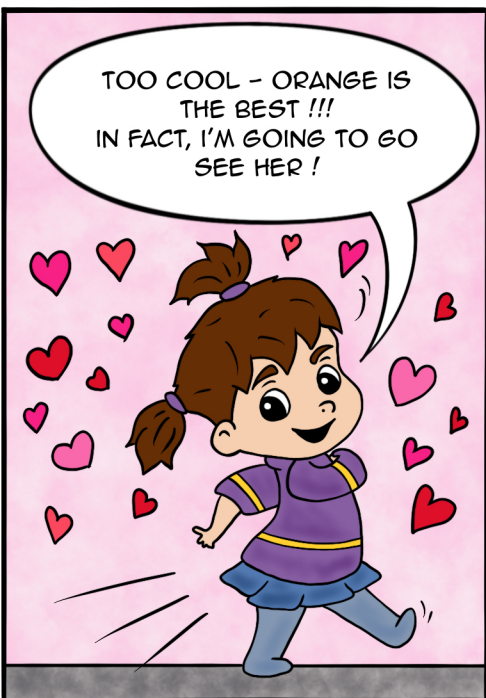
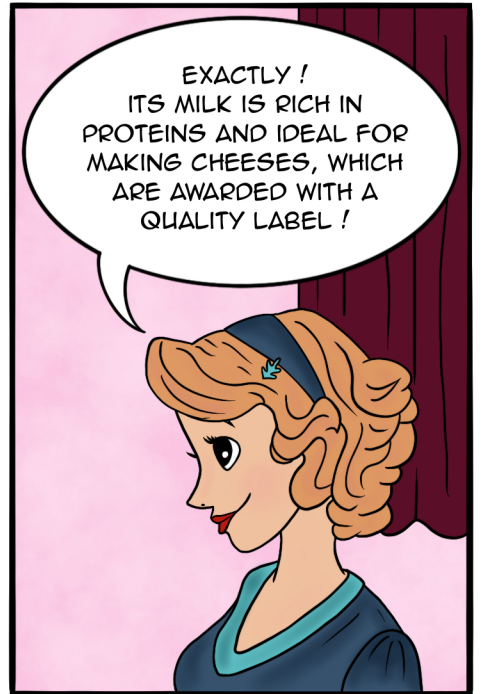
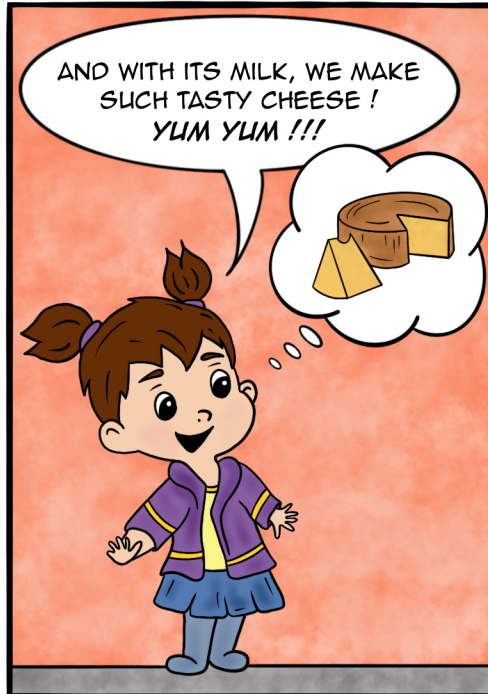
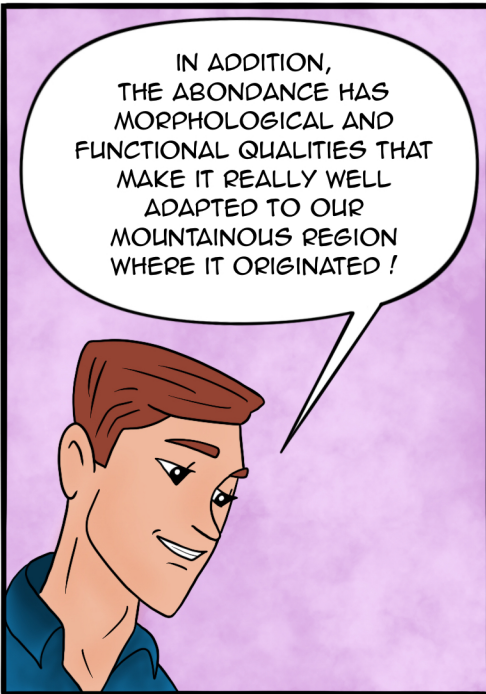
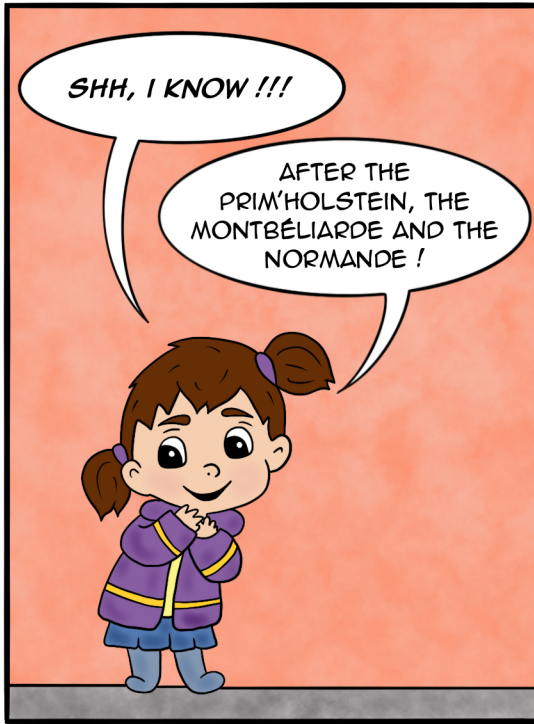
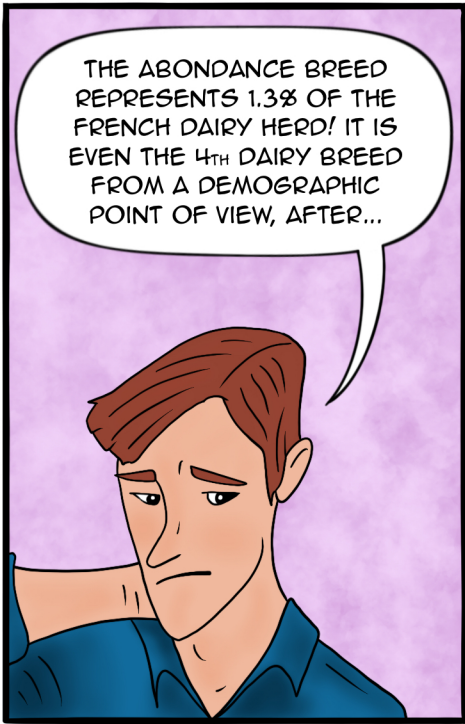
EXACTLY ! THAT'S A LOCAL BREED FROM BRITTANY, WITH VERY FEW INDIVIDUALS. IT'S ACTUALLY IN A CONSERVATION PROGRAM !

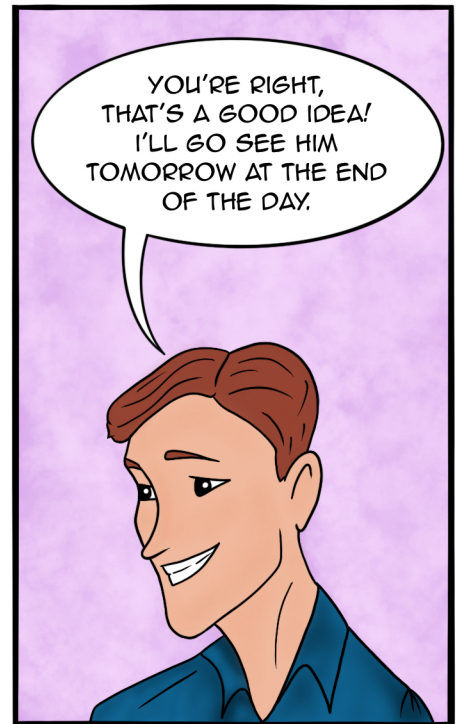
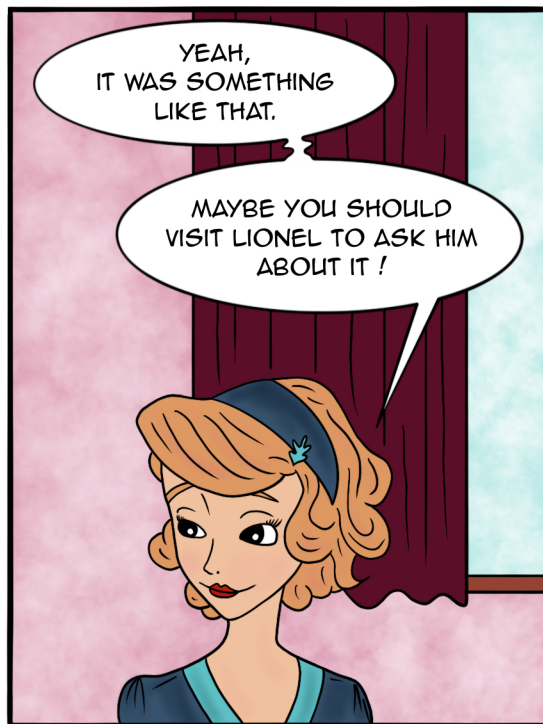
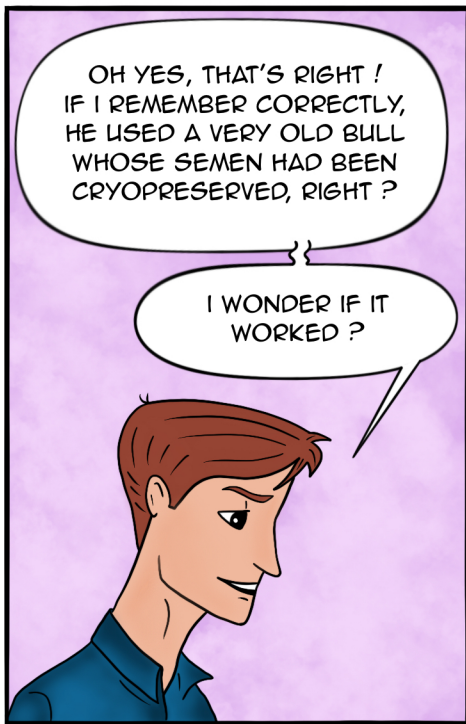


OH YEAH, THEY ARE FUNNY !!! THEY MAKE YELLOW MILK AND ALMOST GOLDEN BUTTER.

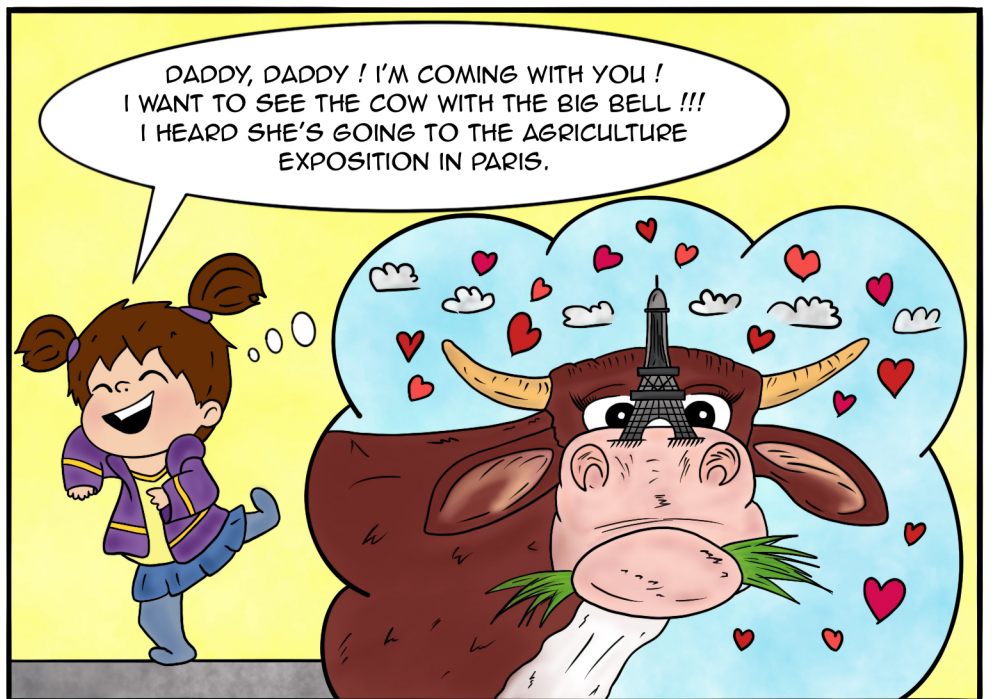
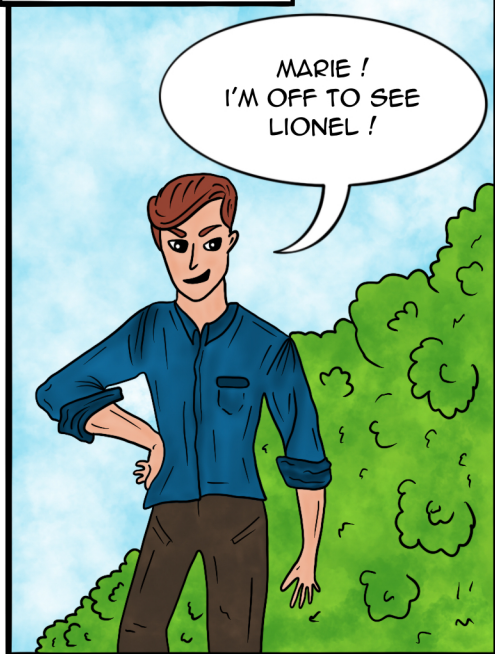


THE ABONDANCE IS ALSO A LOCAL BREED, ORIGINATING FROM OUR REGION, BUT THERE ARE NEARLY 50,000 INDIVIDUALS IN FRANCE.



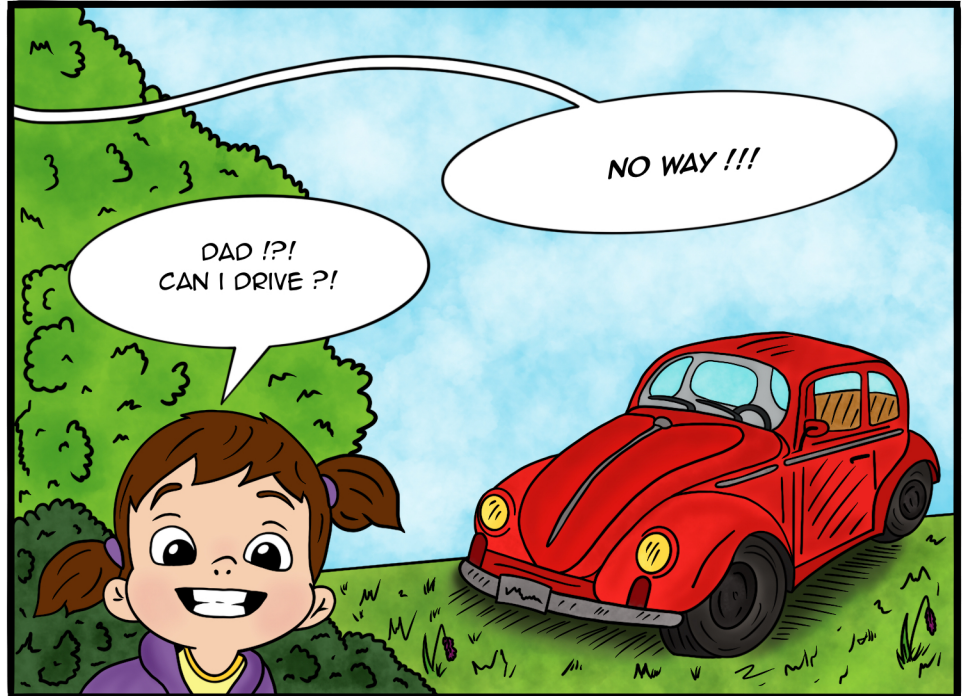
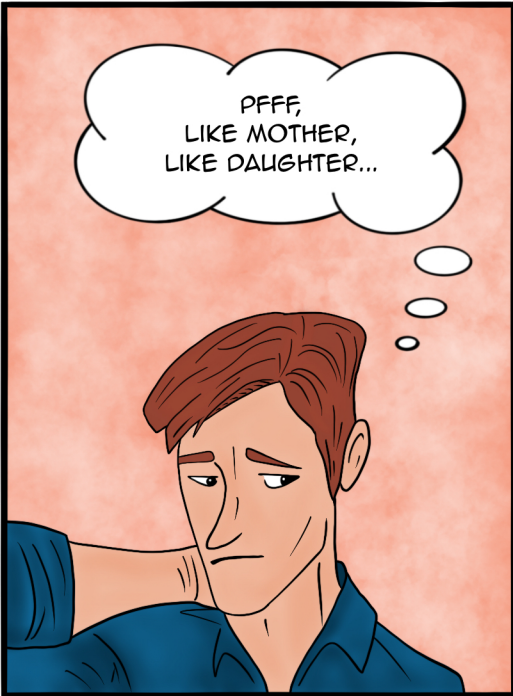
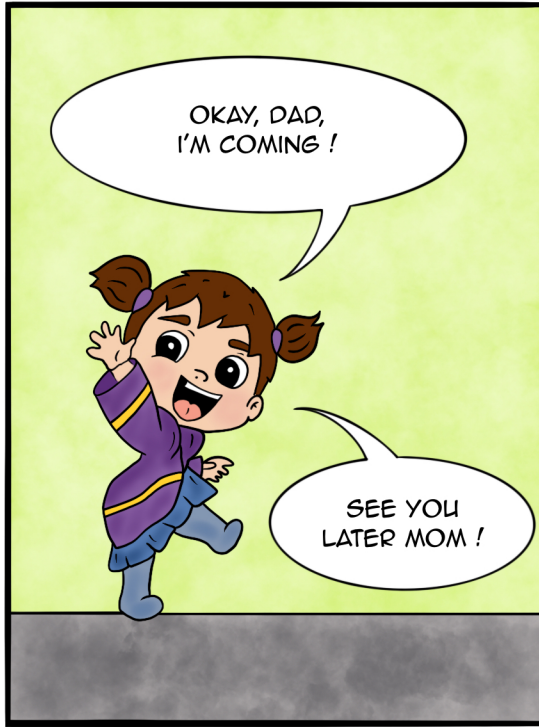


THE NEXT DAY...

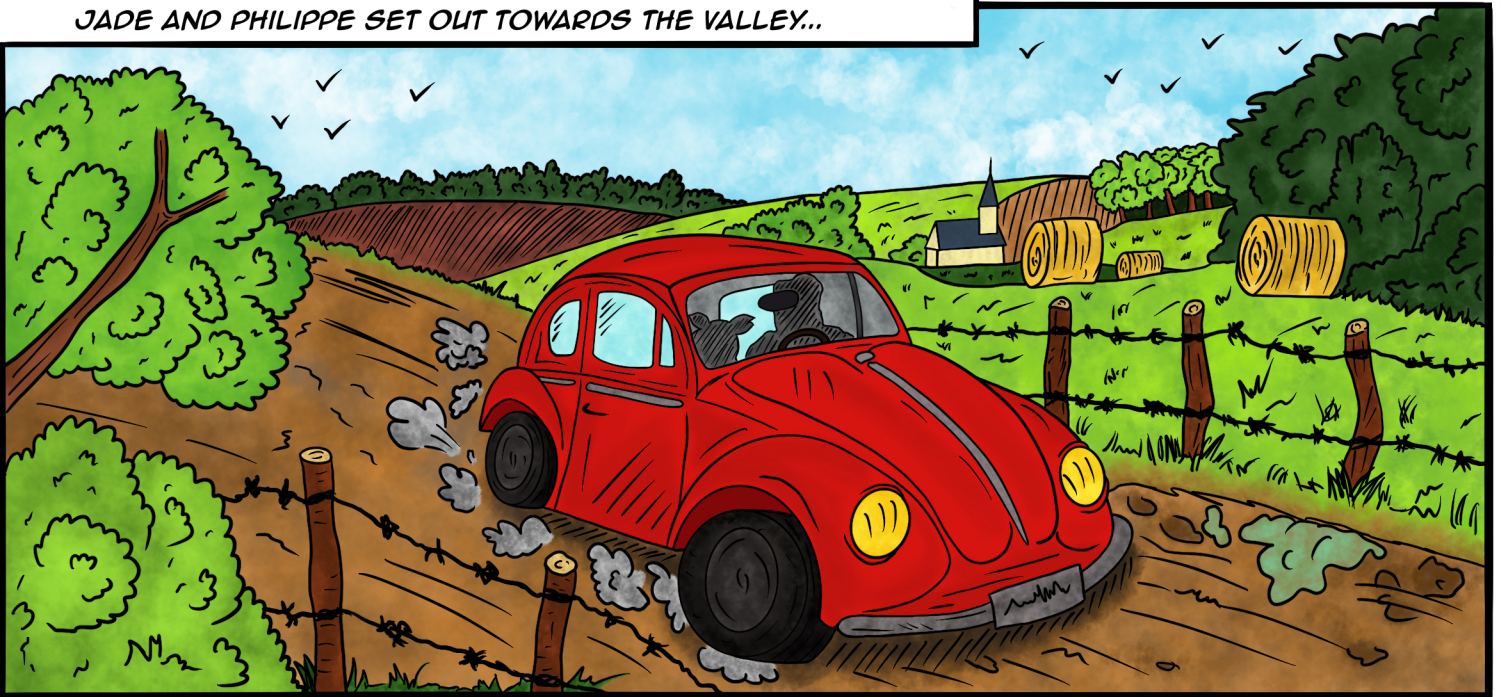


JADE RUNS OFF...

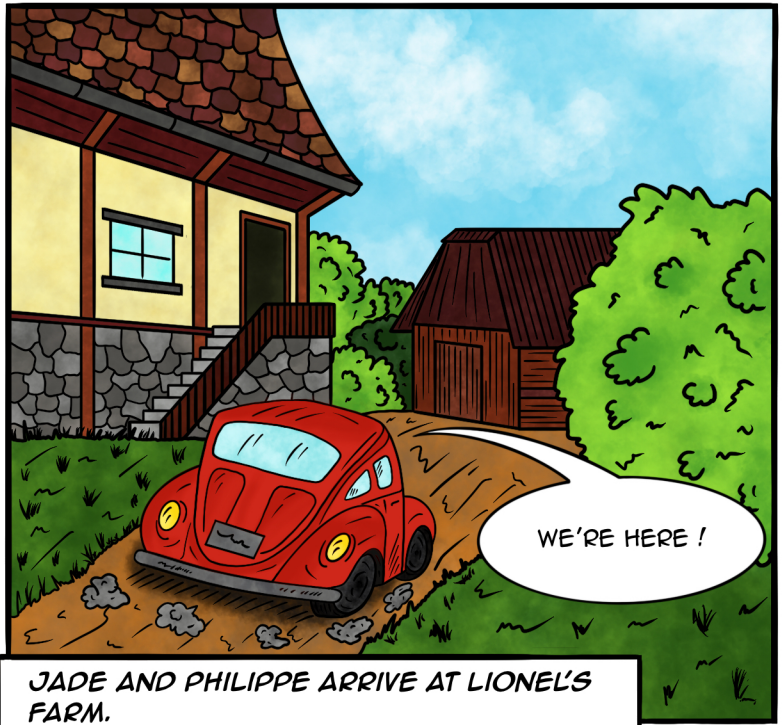
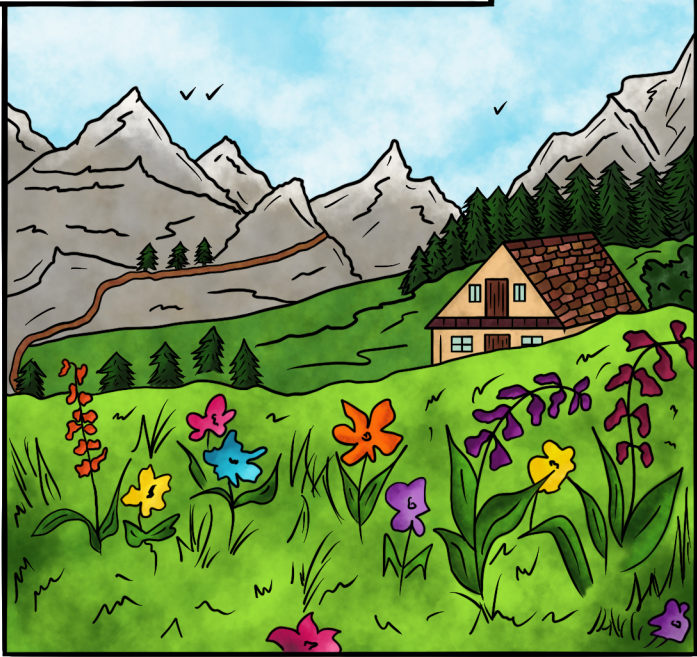




JADE AND PHILIPPE SET OUT TOWARDS THE VALLEY...



SOMEWHERE IN THE VAL
D'ABONDANCE...



JADE AND PHILIPPE ARRIVE AT LIONEL'S
FARM.





DON'T WORRY DAD !
I NEVER GET INTO TROUBLE
ON PURPOSE - IT JUST
HAPPENS NATURALLY !



BUT...

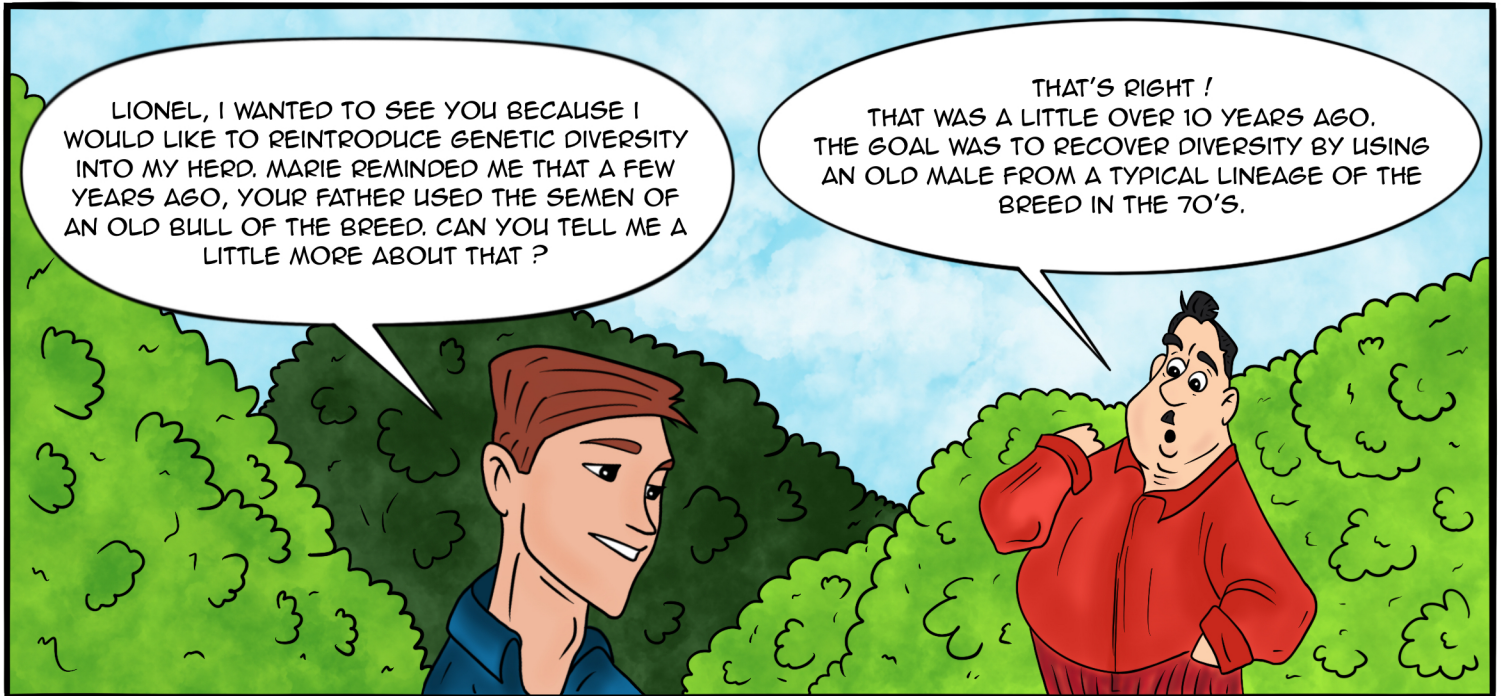
AH AH ! SHE'S
DEFINITELY YOUR
DAUGHTER, NO DOUBT
ABOUT IT.

NO COMMENT...
CRAPULE, GO FOLLOW
JADE. GO ON !



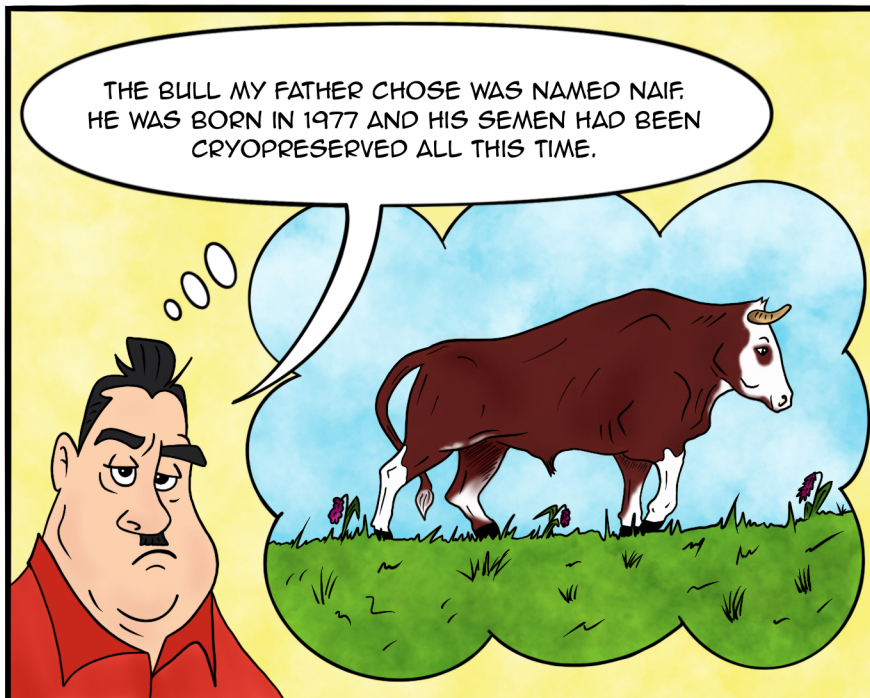
PPFF...
WHY ME ?

WHAT DID I DO
TO DESERVE THIS...



LIONEL, I WANTED TO SEE YOU BECAUSE I
WOULD LIKE TO REINTRODUCE GENETIC DIVERSITY
INTO MY HERD. MARIE REMINDED ME THAT A FEW
YEARS AGO, YOUR FATHER USED THE SEMEN OF
AN OLD BULL OF THE BREED. CAN YOU TELL ME A
LITTLE MORE ABOUT THAT ?

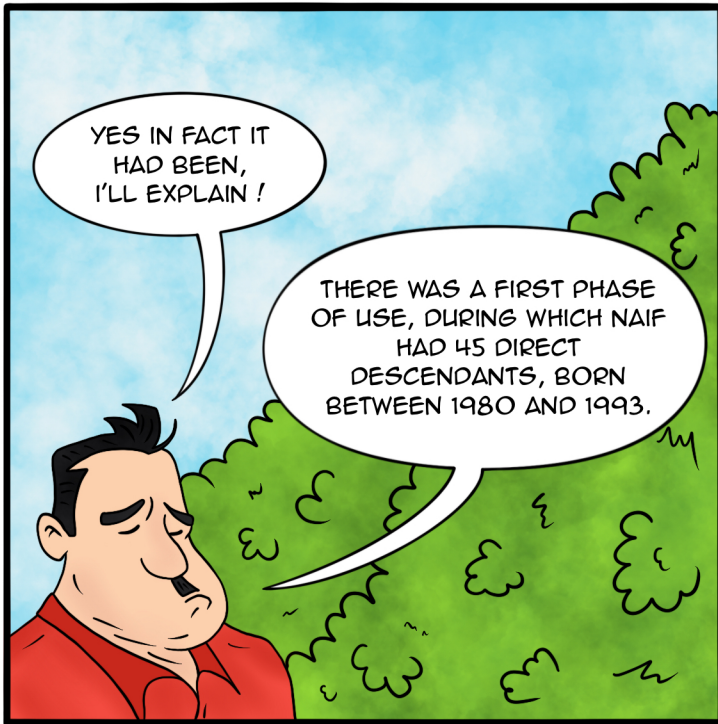
THAT'S RIGHT !
THAT WAS A LITTLE OVER 10 YEARS AGO.
THE GOAL WAS TO RECOVER DIVERSITY BY USING
AN OLD MALE FROM A TYPICAL LINEAGE OF THE
BREED IN THE 70'S.



THE BULL MY FATHER CHOSE WAS NAMED NAIF.
HE WAS BORN IN 1977 AND HIS SEMEN HAD BEEN
CRYOPRESERVED ALL THIS TIME.

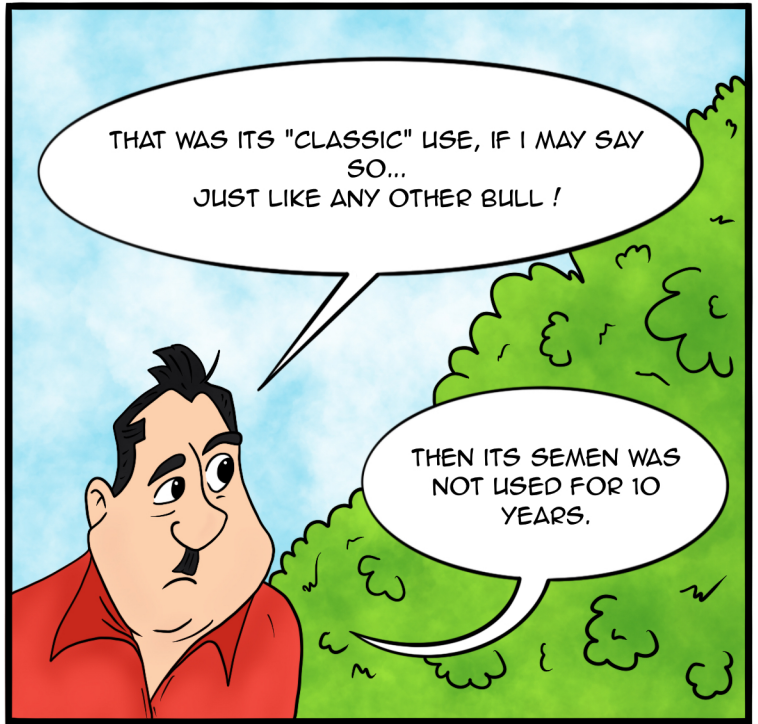


OH, I SEE.
BUT THAT BULL HAD NEVER
BEEN USED AS A SIRE
BEFORE ?



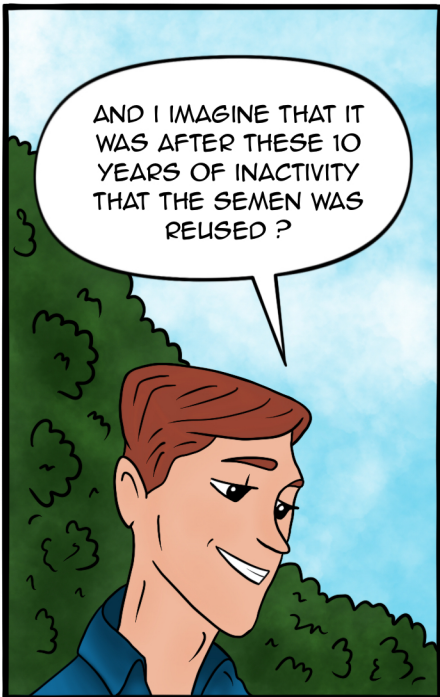
YES IN FACT IT HAD BEEN, I'LL EXPLAIN !

THERE WAS A FIRST PHASE OF USE, DURING WHICH NAIF HAD 45 DIRECT DESCENDANTS, BORN BETWEEN 1980 AND 1993.

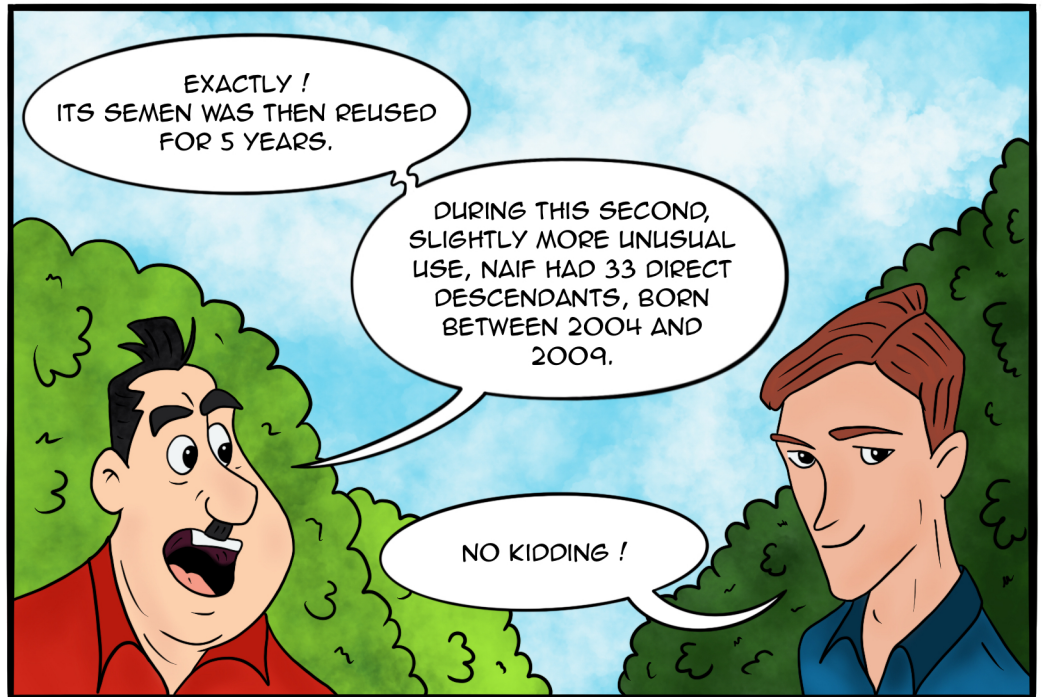


THAT WAS ITS "CLASSIC" USE, IF I MAY SAY SO... JUST LIKE ANY OTHER BULL !

THEN ITS SEMEN WAS NOT USED FOR 10 YEARS.



AND I IMAGINE THAT IT WAS AFTER THESE 10 YEARS OF INACTIVITY THAT THE SEMEN WAS REUSED ?

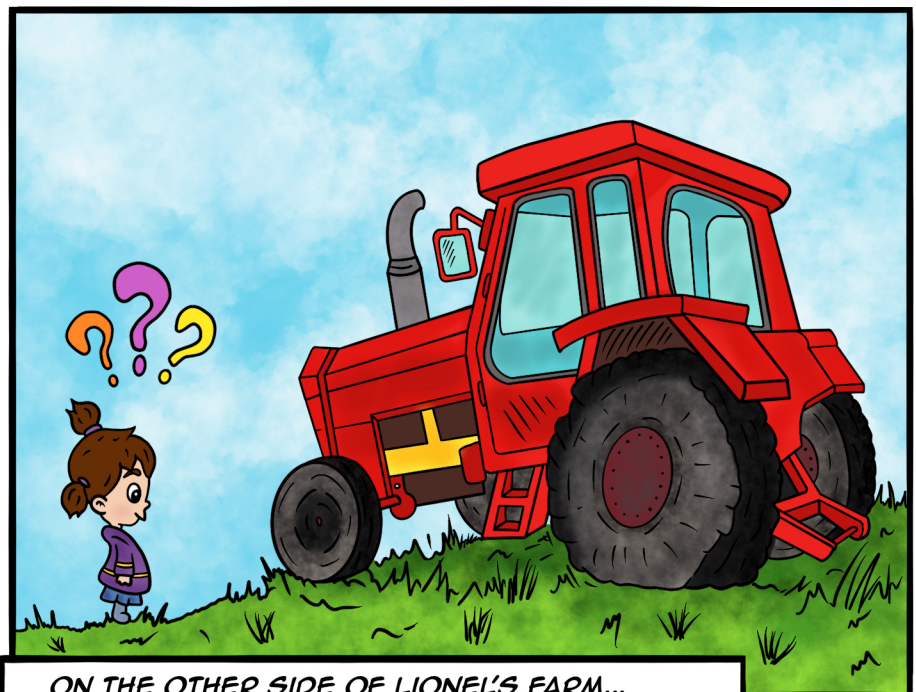


EXACTLY ! ITS SEMEN WAS THEN REUSED FOR 5 YEARS.

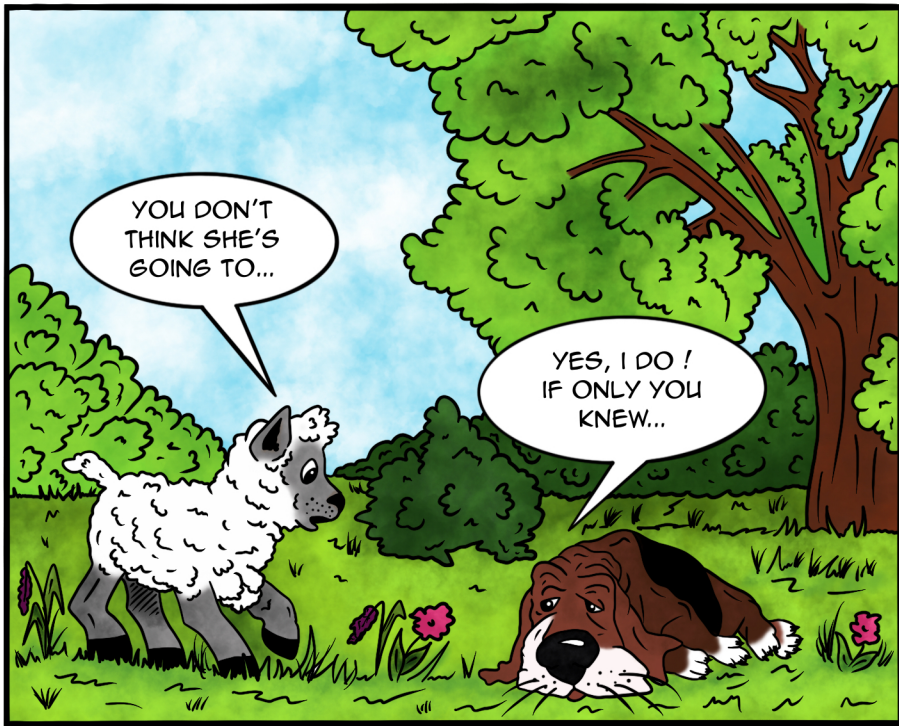
DURING THIS SECOND, SLIGHTLY MORE UNUSUAL USE, NAIF HAD 33 DIRECT DESCENDANTS, BORN BETWEEN 2004 AND 2009.

NO KIDDING !

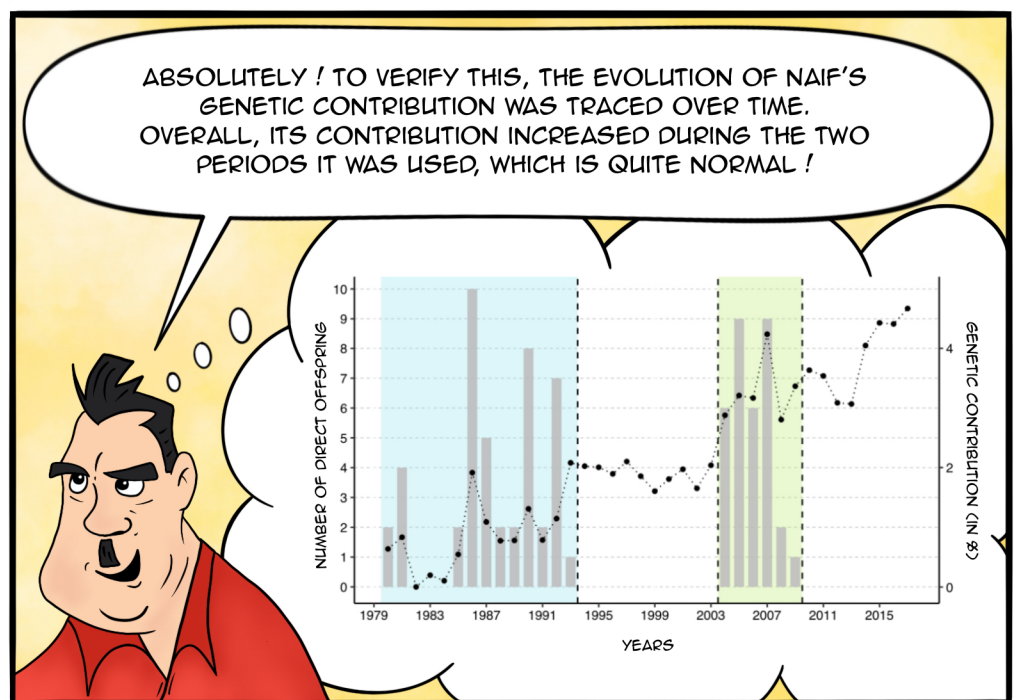
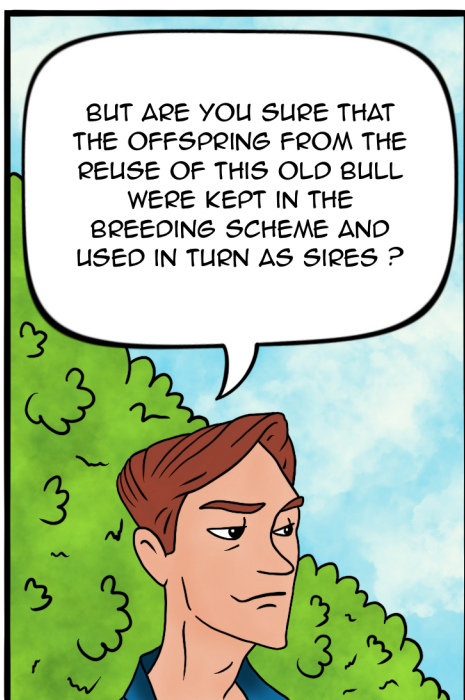
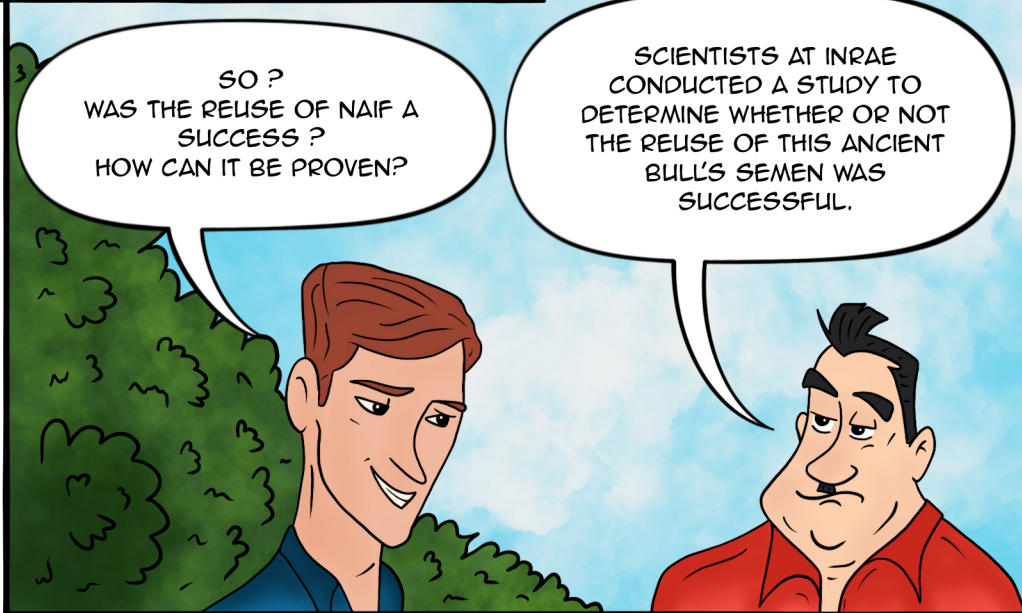
MEANWHILE...

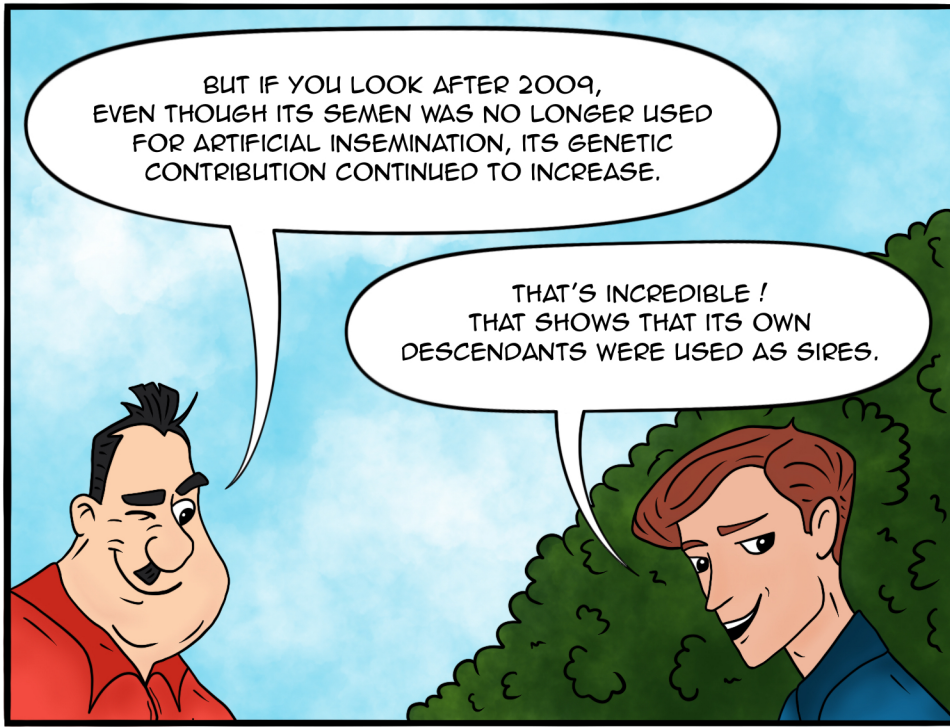


ON THE OTHER SIDE OF LIONEL'S FARM...



PHILIPPE AND LIONEL CONTINUE THEIR DISCUSSION.





BUT IF YOU LOOK AFTER 2009, EVEN THOUGH ITS SEMEN WAS NO LONGER USED FOR ARTIFICIAL INSEMININATION, ITS GENETIC CONTRIBUTION CONTINUED TO INCREASE.

THAT'S INCREDIBLE ! THAT SHOWS THAT ITS OWN DESCENDANTS WERE USED AS SIRE.



JADE COMES IN WHISTLING.



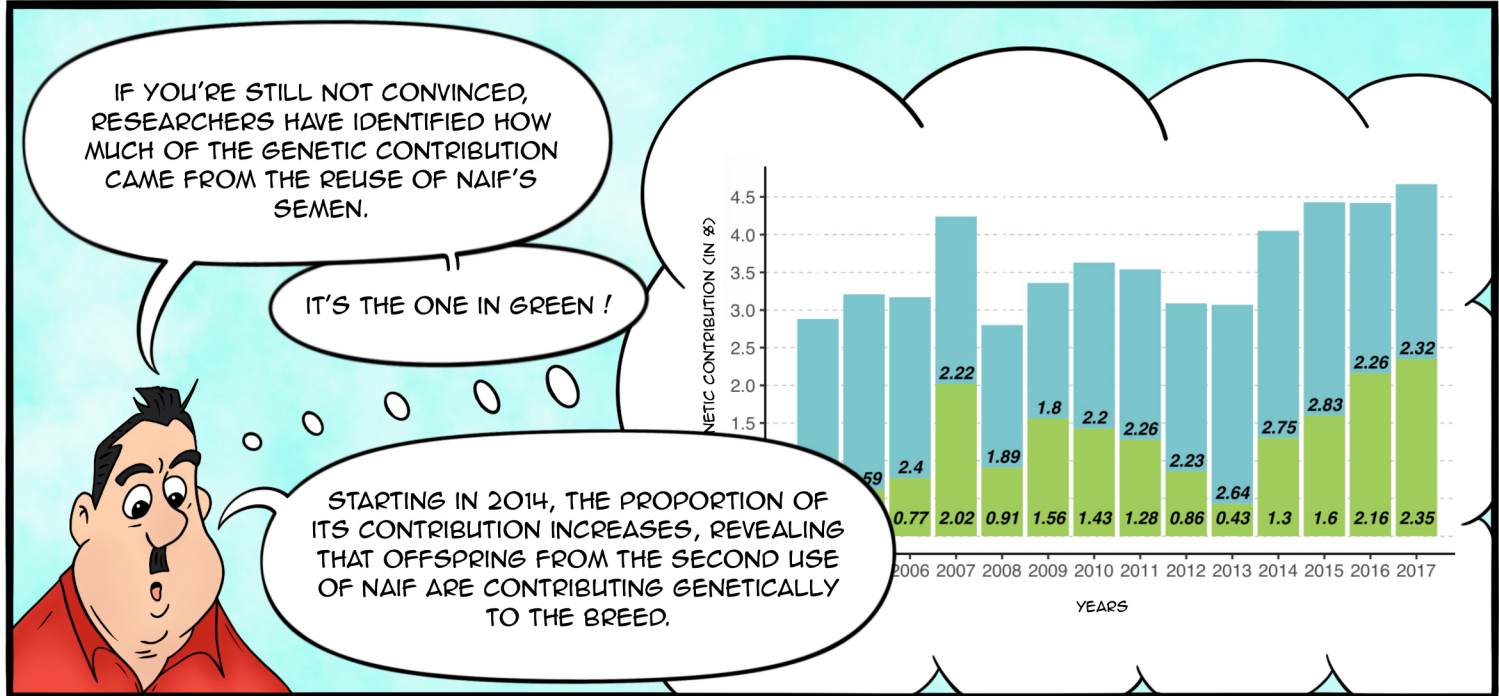
DADDY, DADDY ! LOOK, I MADE A FLOWER CROWN FOR ORANGE !

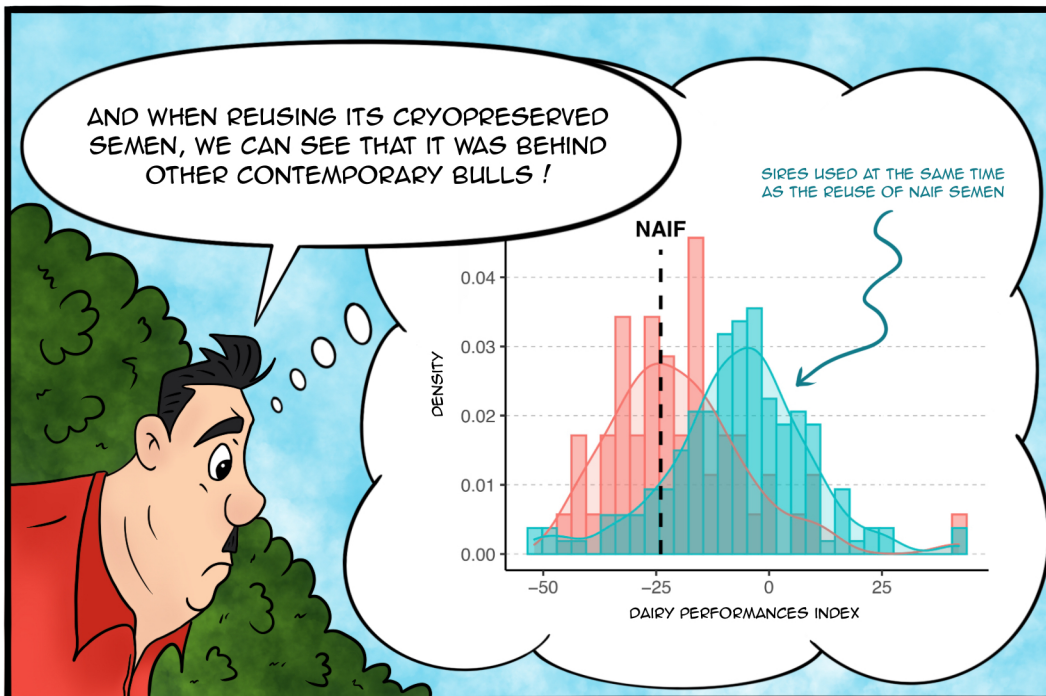
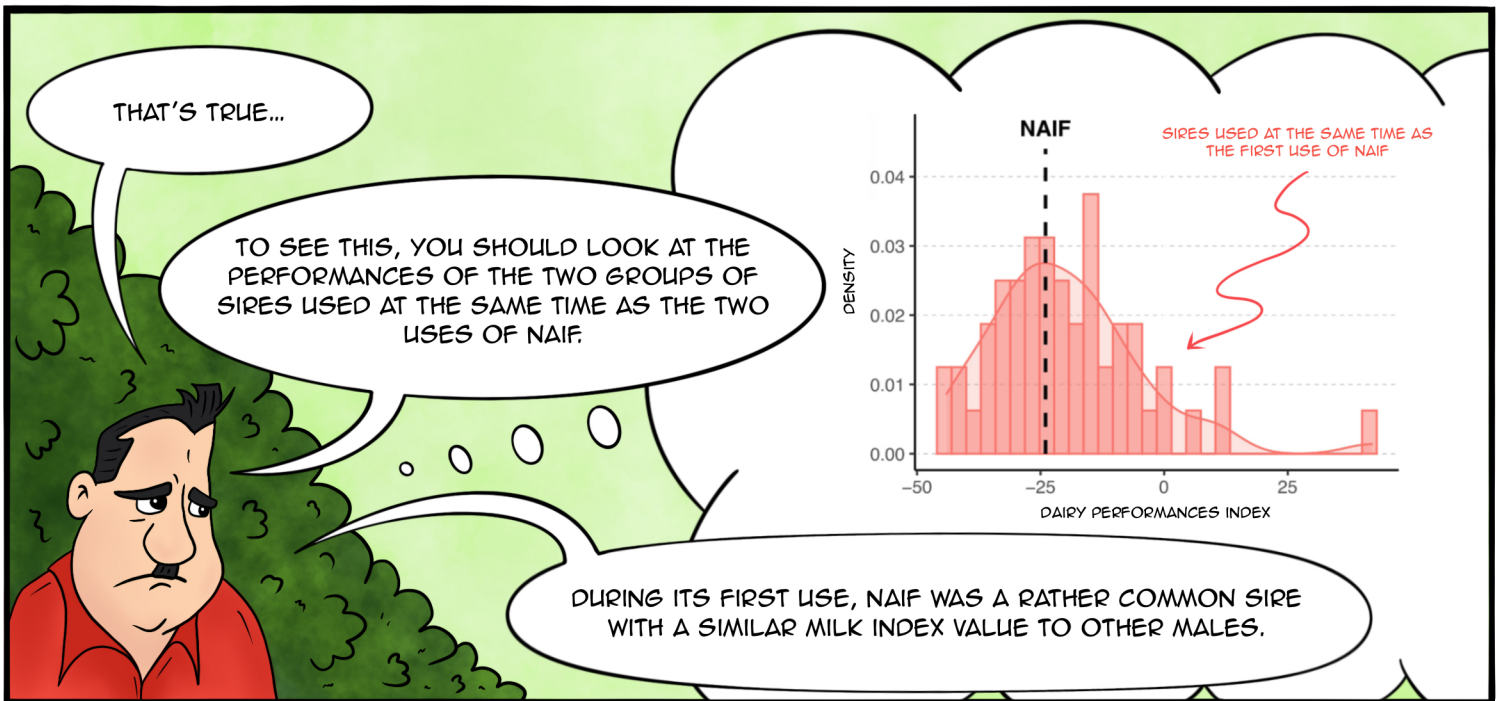
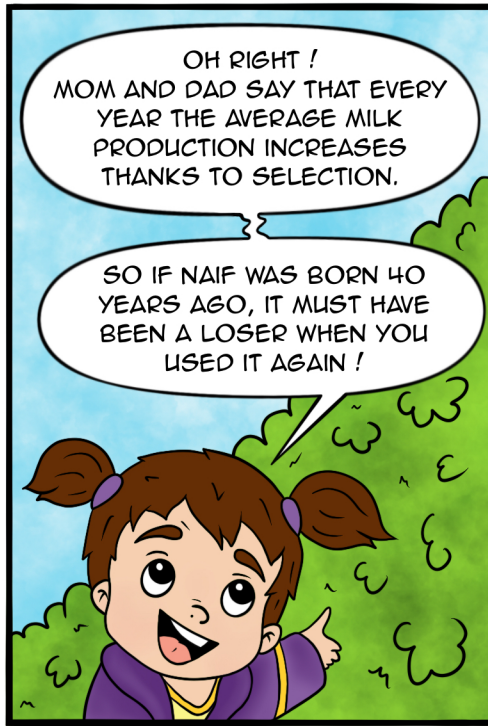


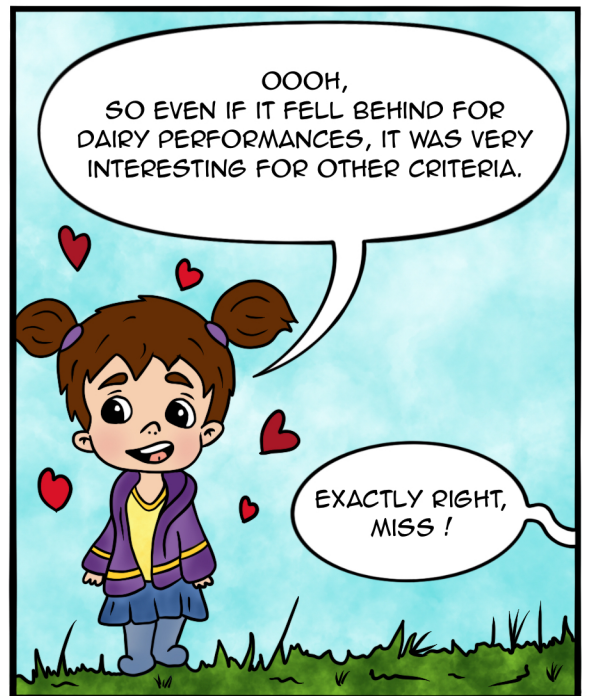
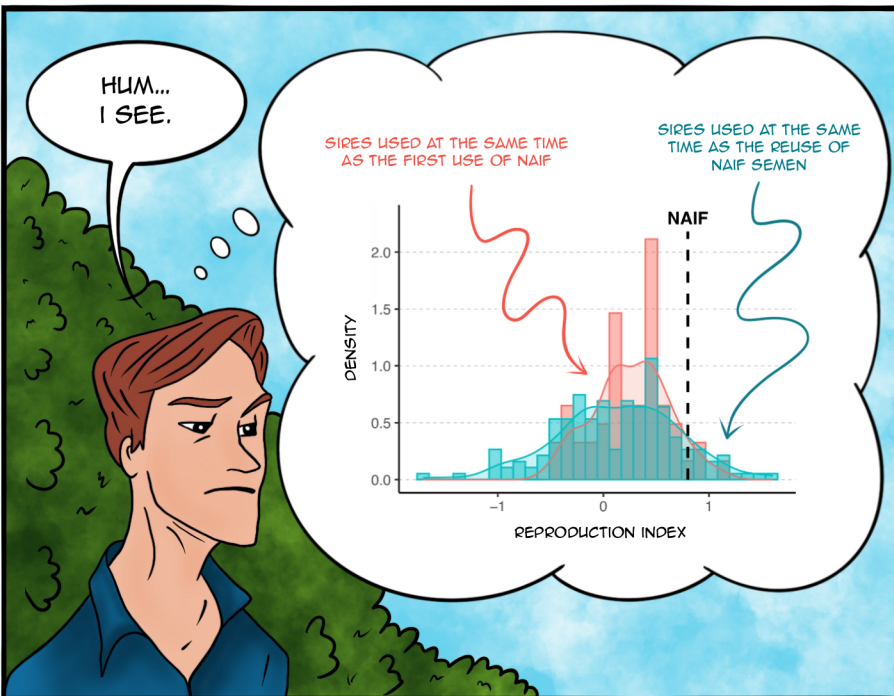
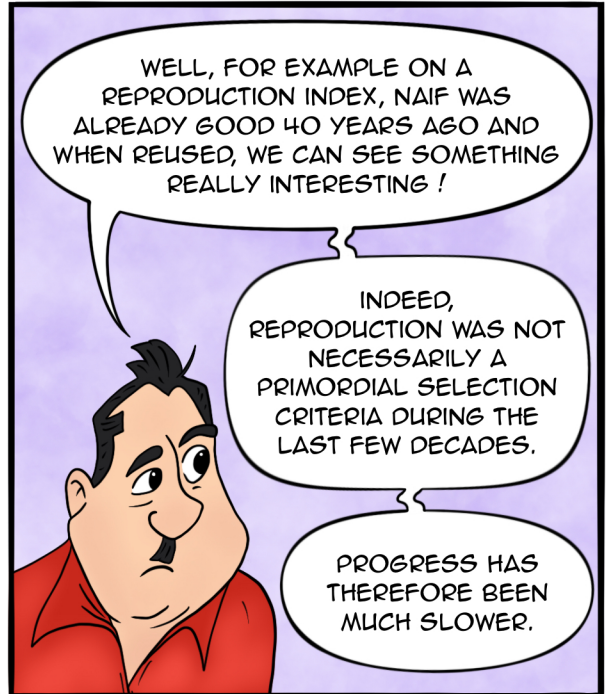
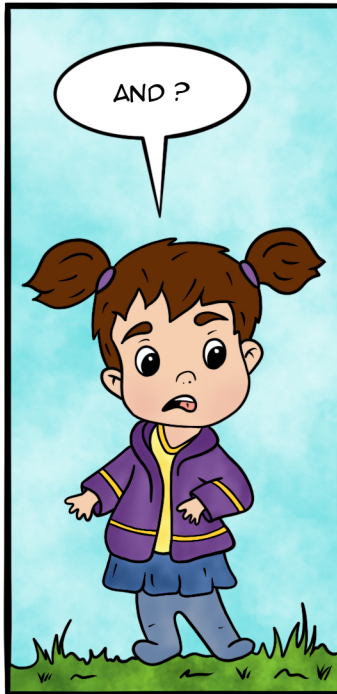
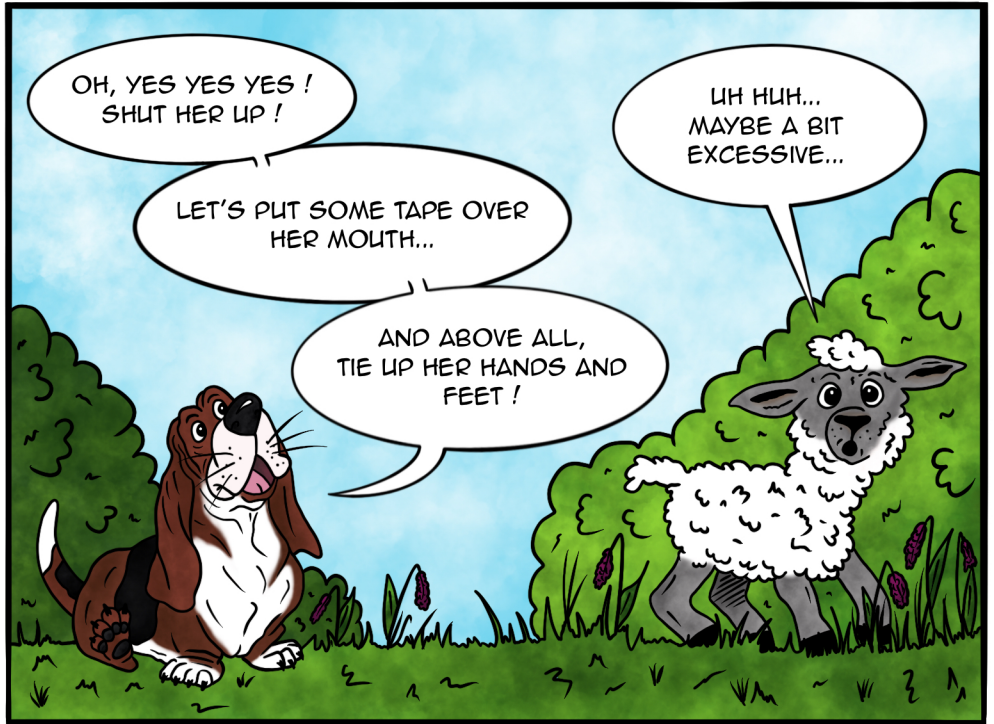
MMHMM, THAT'S NICE...

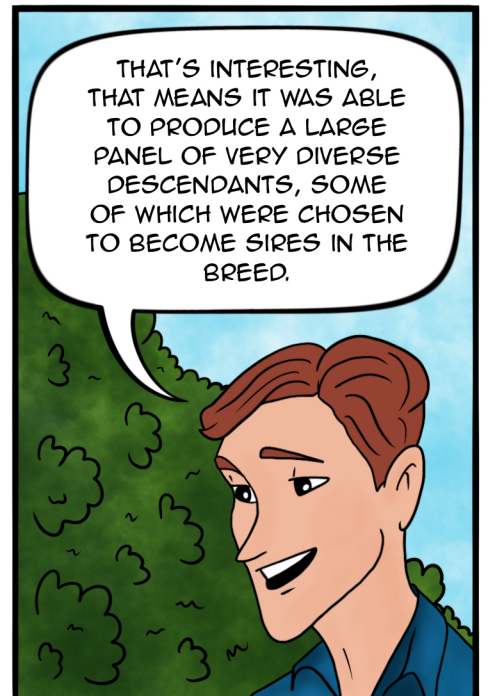
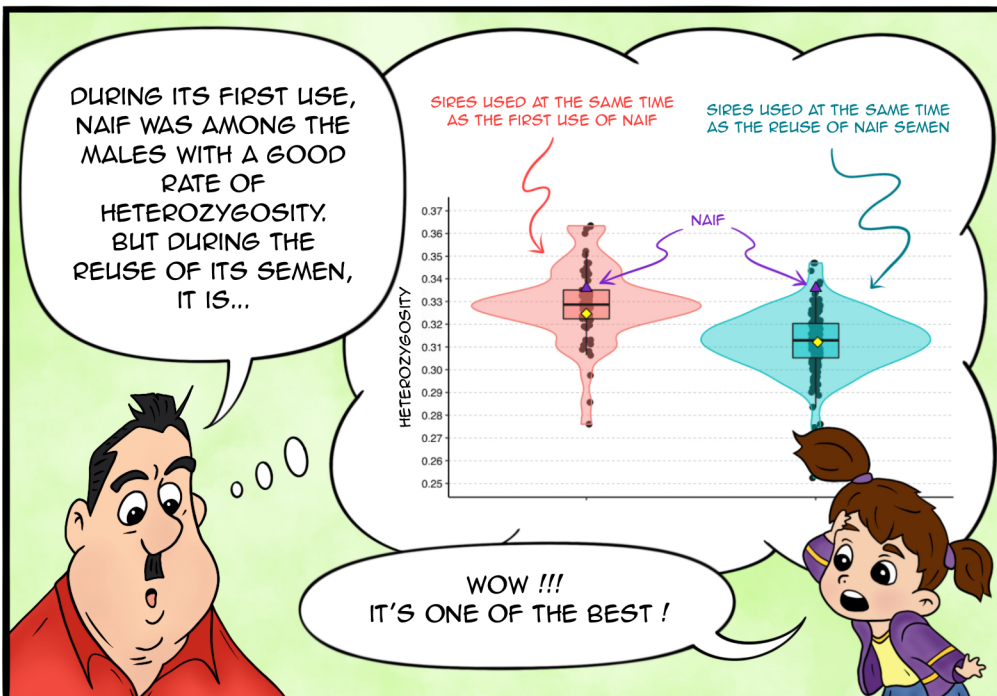
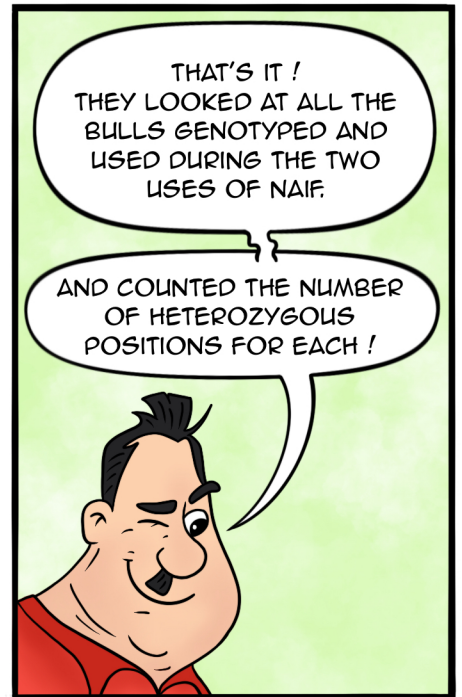
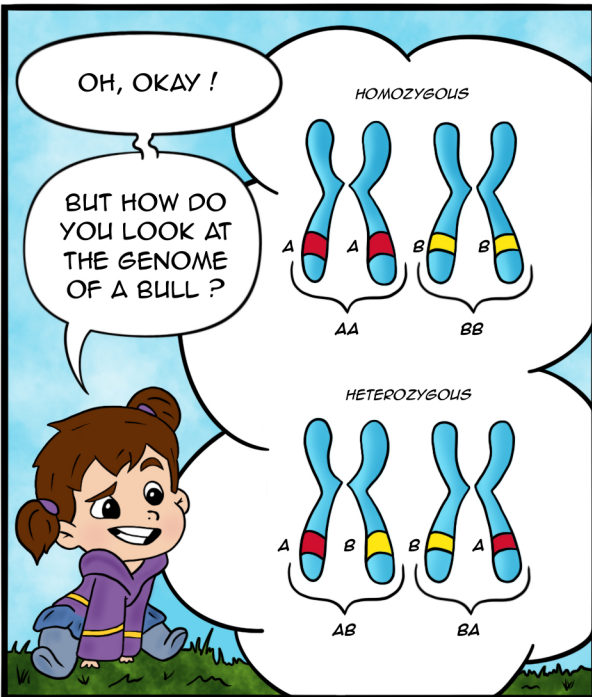
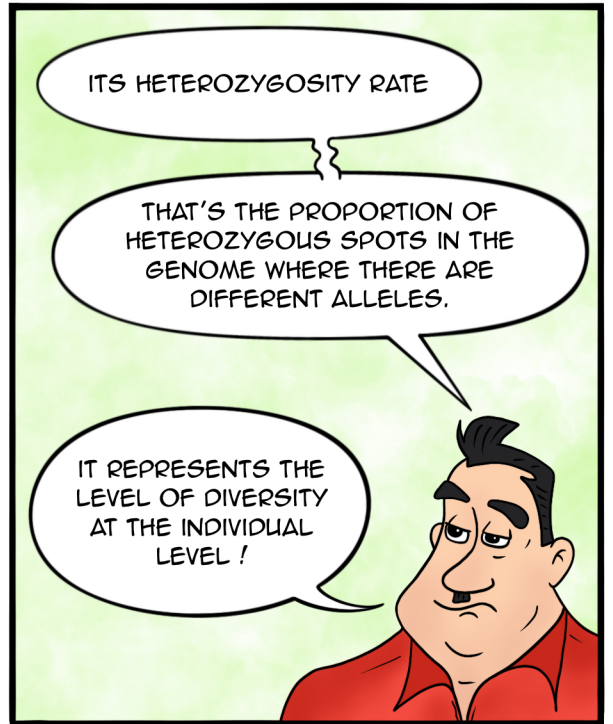
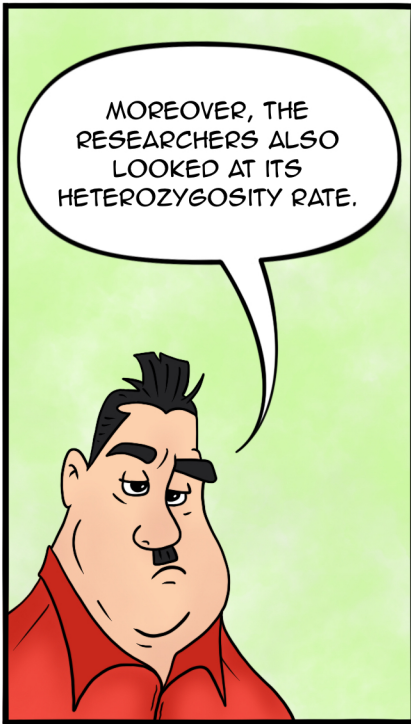


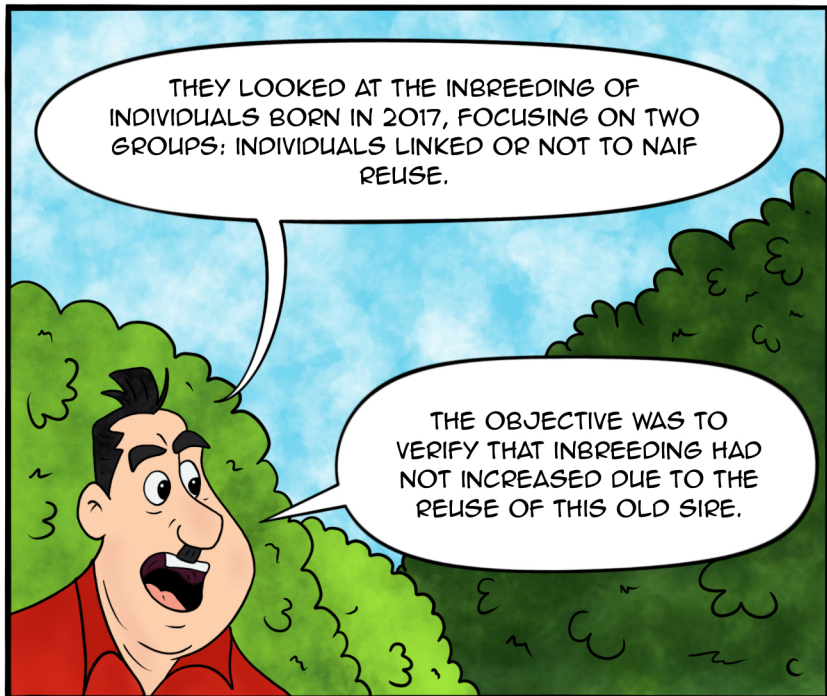
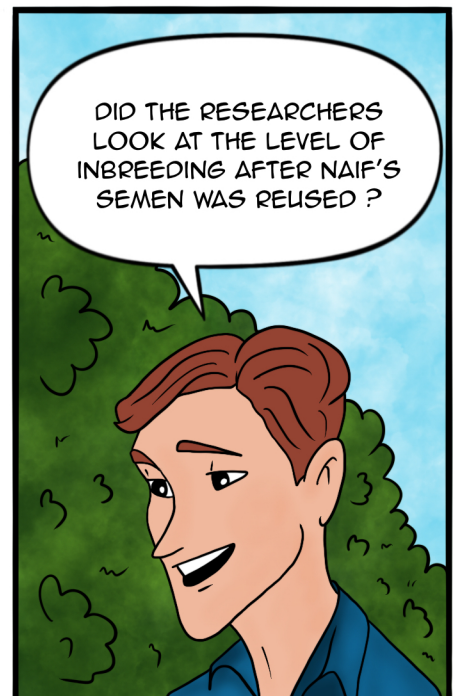
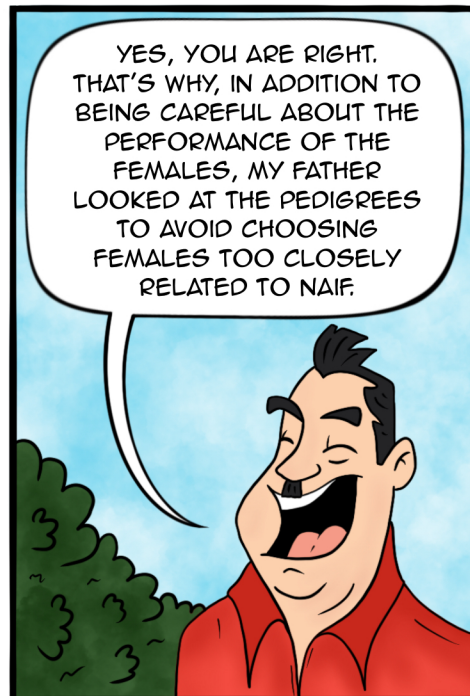
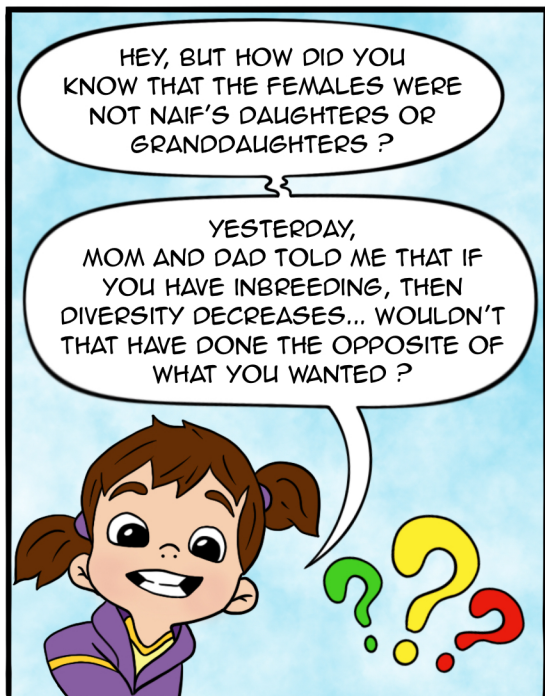
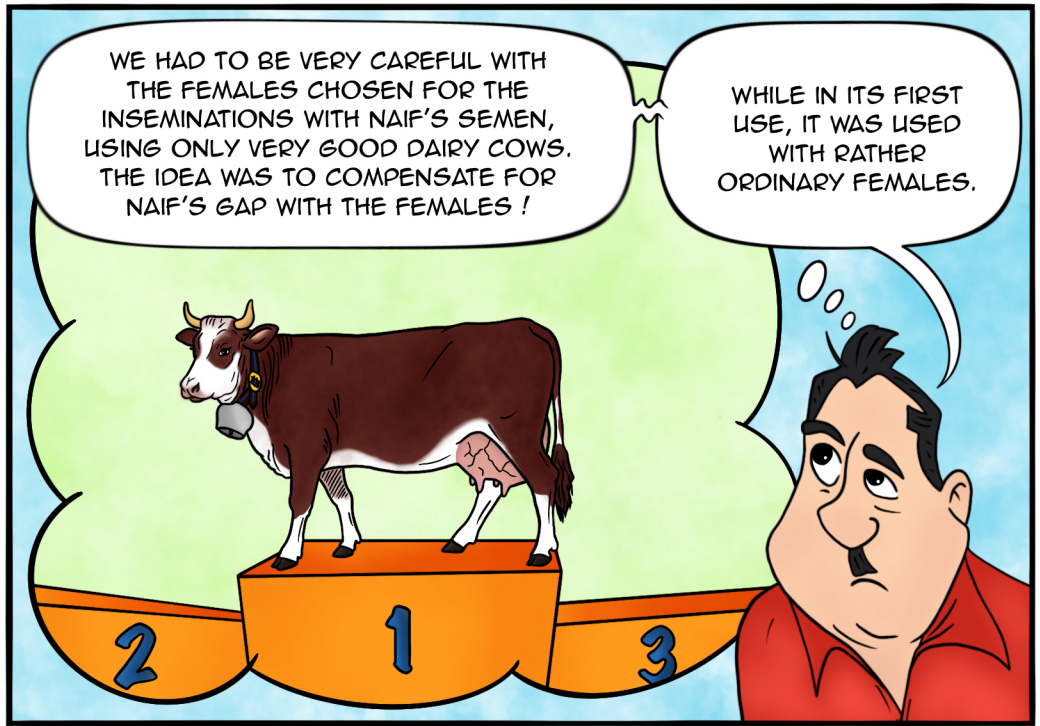
IT'S GOING TO LOOK GREAT ! BETTER THAN A BIG OLD BELL...

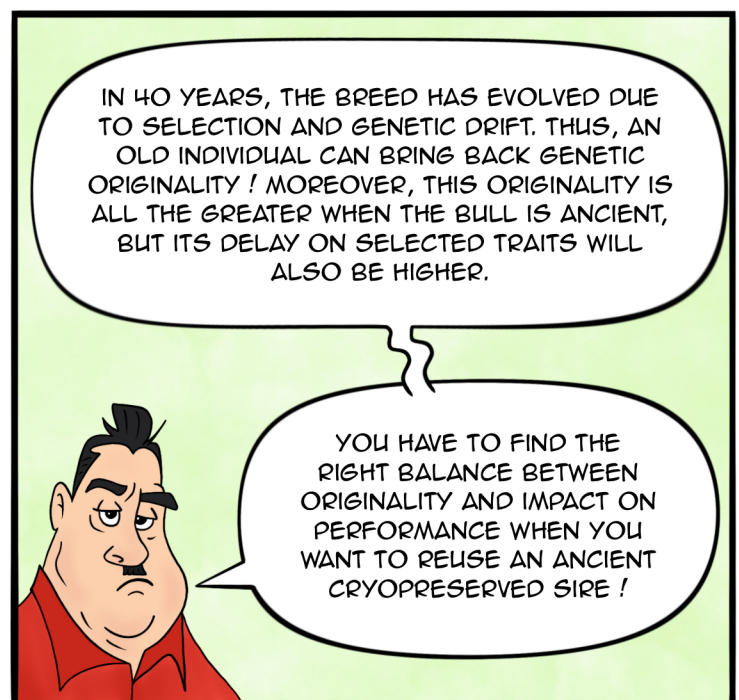
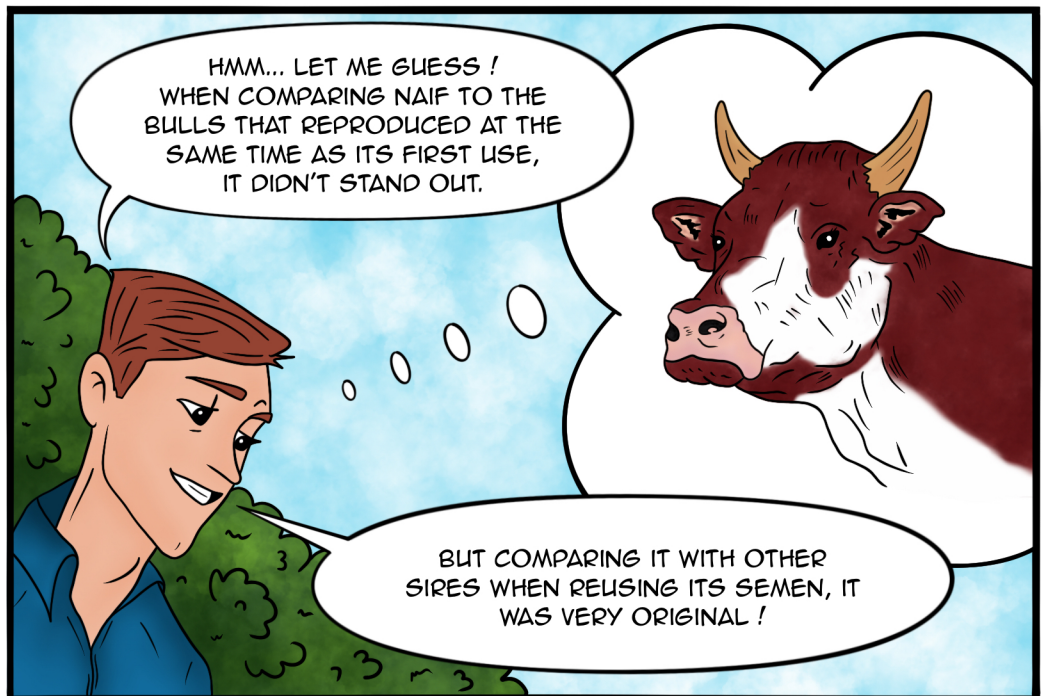
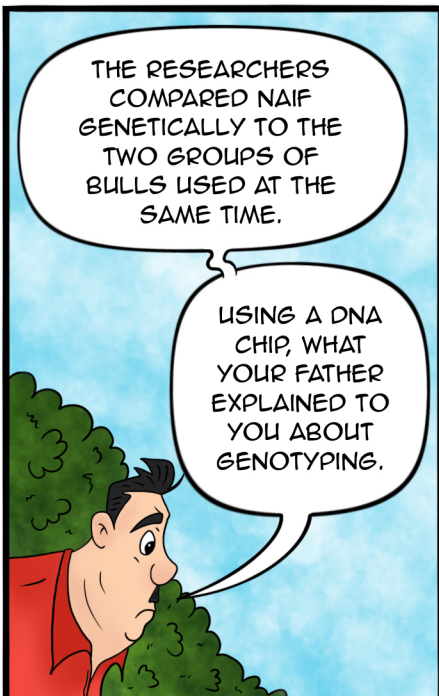
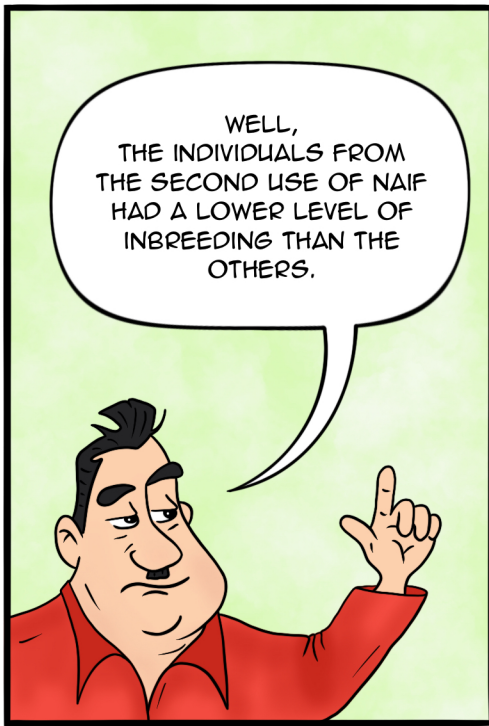


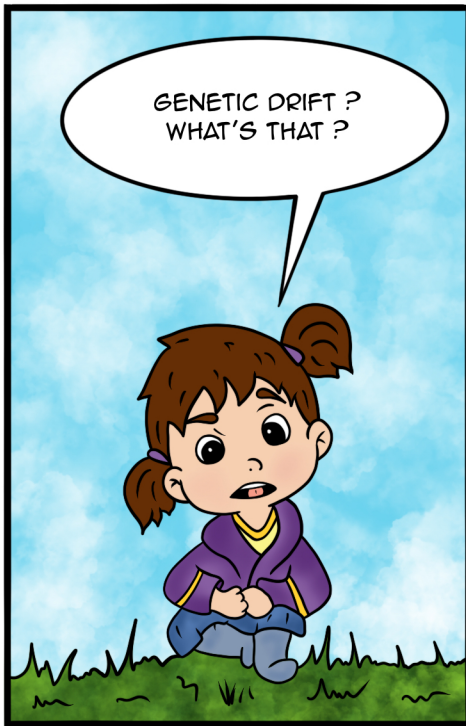




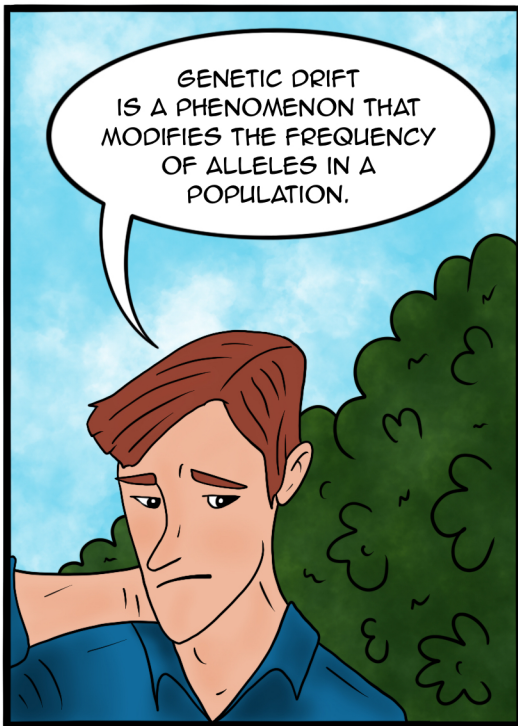




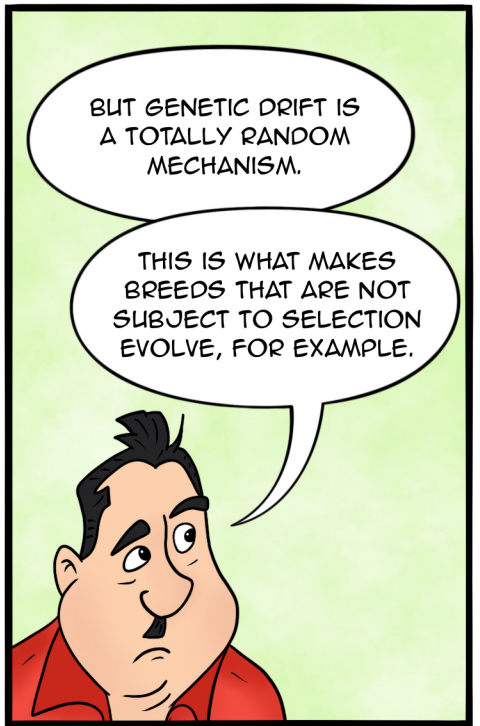




GENETIC DRIFT ?
WHAT'S THAT ?



GENETIC DRIFT
IS A PHENOMENON THAT
MODIFIES THE FREQUENCY
OF ALLELES IN A
POPULATION.



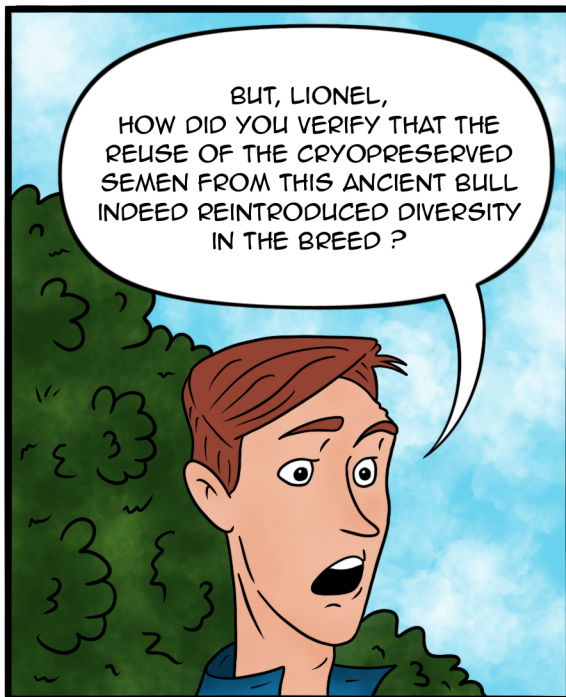
BUT GENETIC DRIFT IS
A TOTALLY RANDOM
MECHANISM.

THIS IS WHAT MAKES
BREEDS THAT ARE NOT
SUBJECT TO SELECTION
EVOLVE, FOR EXAMPLE.



OH RIGHT, I GET IT !
IT'S DUE TO CHANCE.

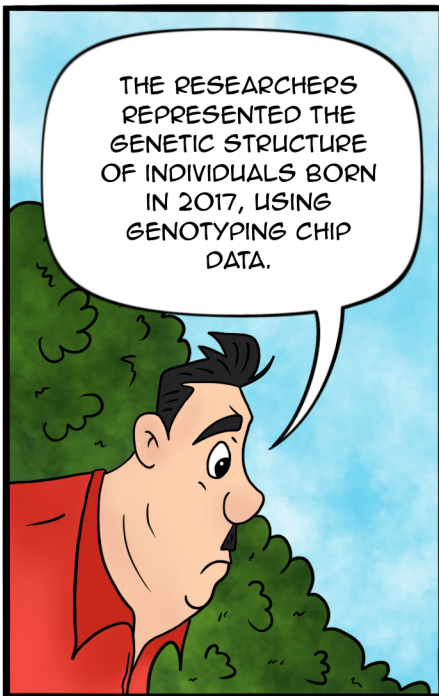
EXACTLY !



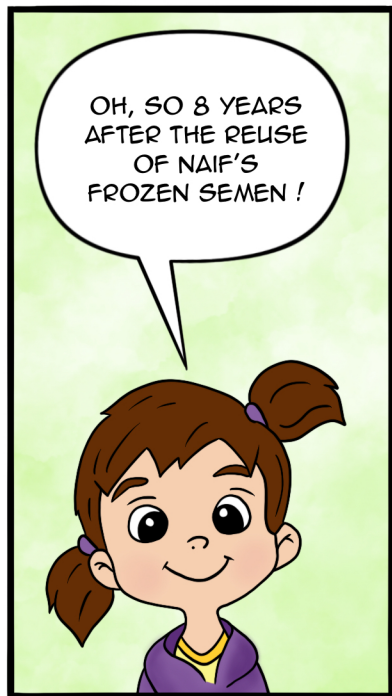
BUT, LIONEL,
HOW DID YOU VERIFY THAT THE
REUSE OF THE CRYOPRESERVED
SEMEN FROM THIS ANCIENT BULL
INDEED REINTRODUCED DIVERSITY
IN THE BREED ?



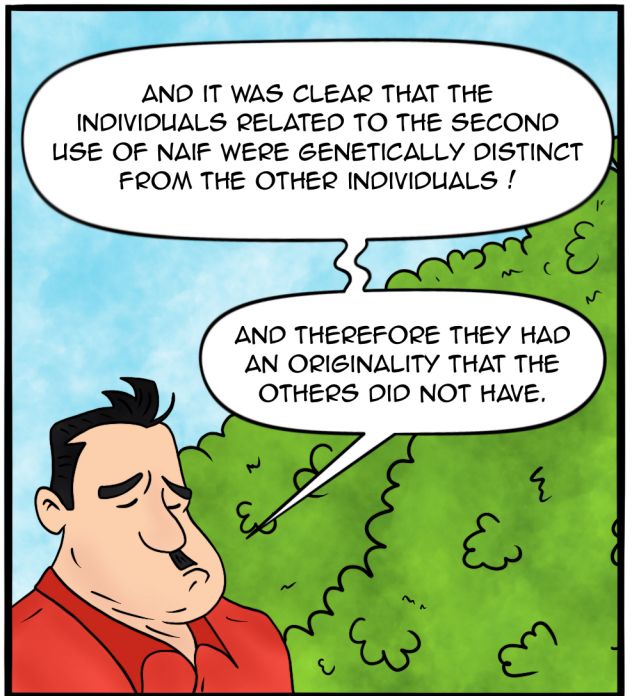
AH AH,
SO MANY QUESTIONS
PHILIPPE !
LET ME EXPLAIN...



THE RESEARCHERS
REPRESENTED THE
GENETIC STRUCTURE
OF INDIVIDUALS BORN
IN 2017, USING
GENOTYPING CHIP
DATA.

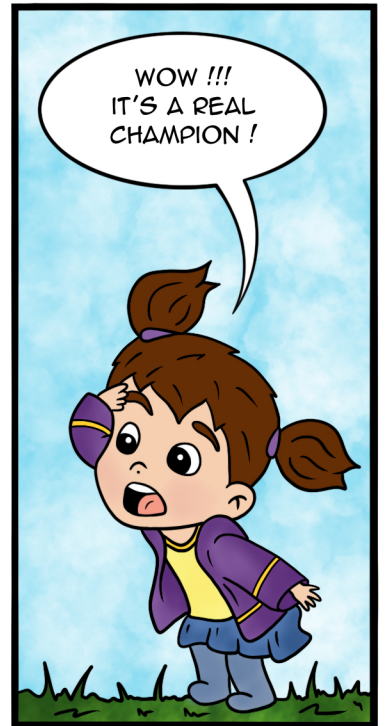
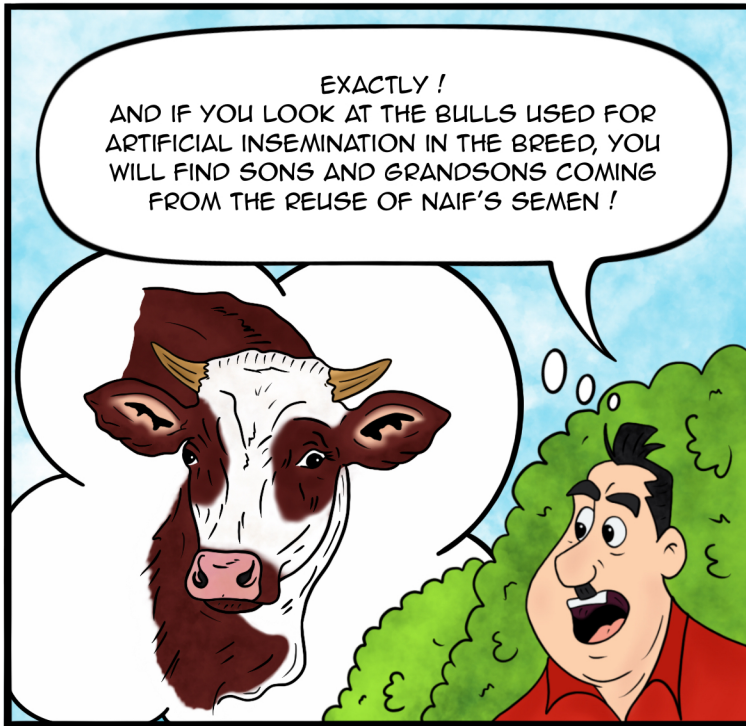


OH, SO 8 YEARS
AFTER THE REUSE
OF NAIF'S
FROZEN SEMEN !



AND IT WAS CLEAR THAT THE
INDIVIDUALS RELATED TO THE SECOND
USE OF NAIF WERE GENETICALLY DISTINCT
FROM THE OTHER INDIVIDUALS !

AND THEREFORE THEY HAD
AN ORIGINALITY THAT THE
OTHERS DID NOT HAVE.

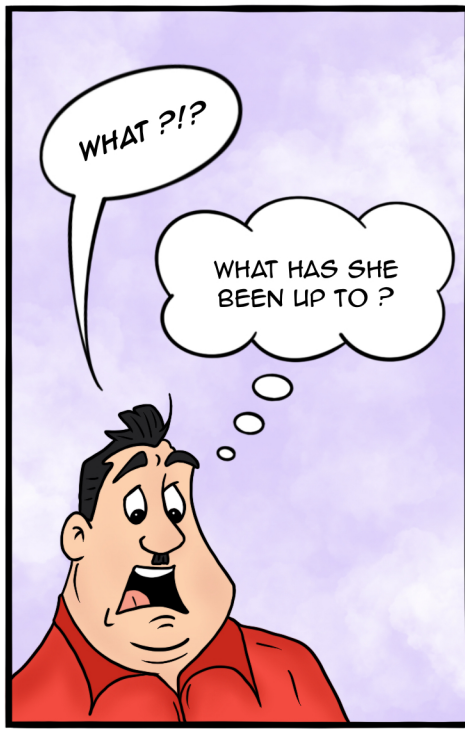


OVER BY THE HENHOUSE...





IT'S THE LITTLE CAP FROM YOUR TRACTOR WHEEL !



WHAT ?!?

WHAT HAS SHE BEEN UP TO ?



OH NO... PLEASE TELL ME SHE DIDN'T DO THAT...



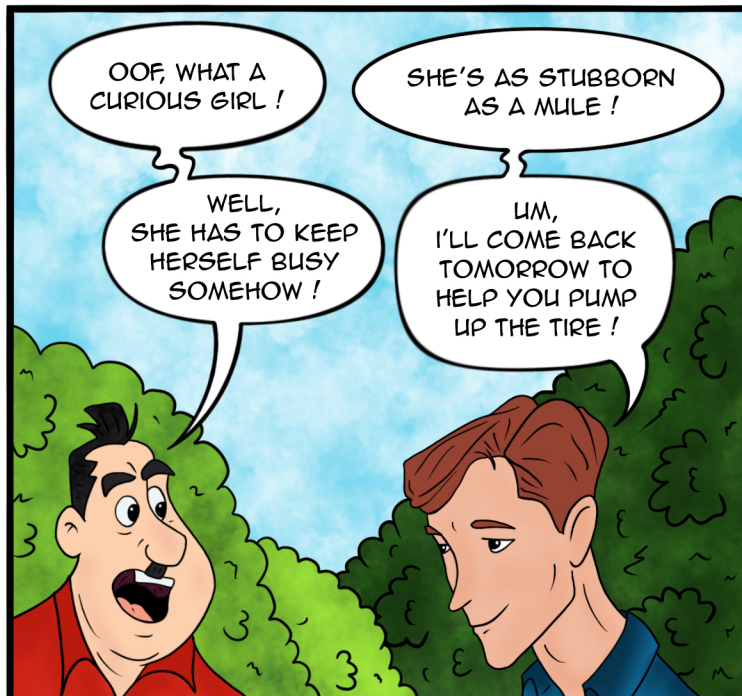
I WANTED TO KNOW WHAT IT IS FOR... WELL, I GUESS IT HOLDS IN THE AIR !



I CAN'T BELIEVE IT ! JADE GET IN THE CAR ! NOW !



I DON'T GET WHY HE'S SO UPSET... I MEAN AT LEAST I DIDN'T DO IT ON HIS TRACTOR !

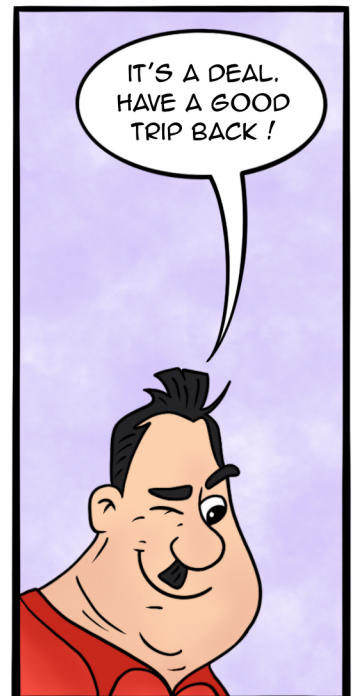


OOF, WHAT A CURIOUS GIRL !

SHE'S AS STUBBORN AS A MULE !

WELL, SHE HAS TO KEEP HERSELF BUSY SOMEHOW !

UM, I'LL COME BACK TOMORROW TO HELP YOU PUMP UP THE TIRE !



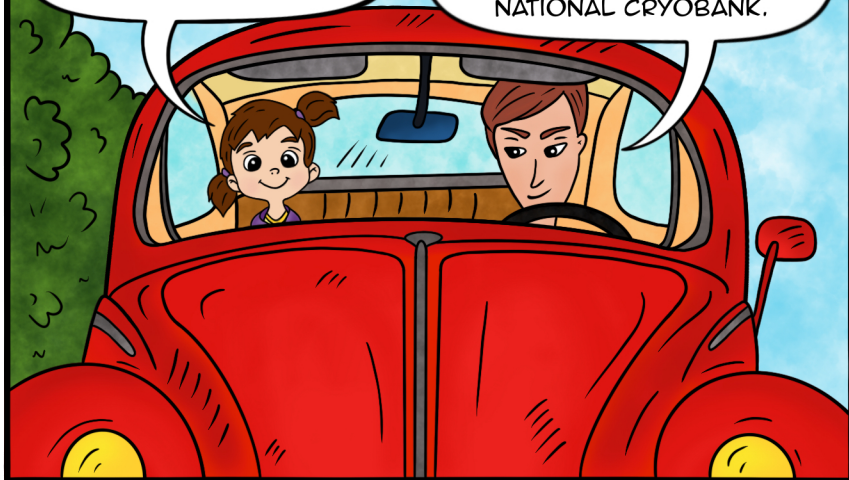
IT'S A DEAL. HAVE A GOOD TRIP BACK !

JADE AND PHILIPPE TAKE THE ROAD TOWARDS THE HOUSE.



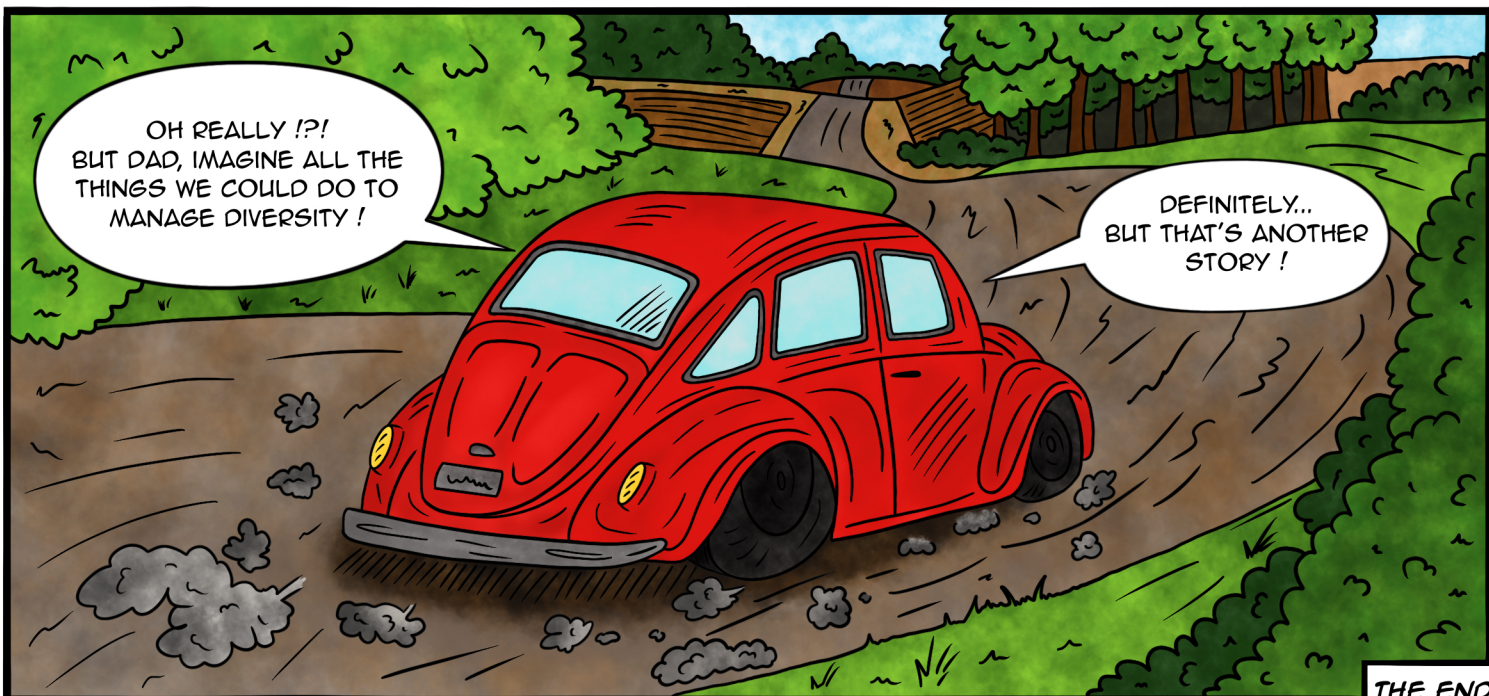
IT'S AMAZING WHAT LIONEL AND HIS FATHER WERE ABLE TO DO WITH THE CRYOPRESERVED SEMEN FROM THAT ANCIENT BULL, NAIF !

YES, IT'S TRUE ! AND YOU KNOW, THERE ARE ACTUALLY MANY CRYOPRESERVED INDIVIDUALS OF DIFFERENT SPECIES AND BREEDS ! FOR EXAMPLE, IN THE FRENCH NATIONAL CRYOBANK.



OH REALLY !?! BUT DAD, IMAGINE ALL THE THINGS WE COULD DO TO MANAGE DIVERSITY !

DEFINITELY... BUT THAT'S ANOTHER STORY !



THE END

IF YOU WOULD LIKE MORE INFORMATION ON THE REUSE OF NAIF, PLEASE GO HERE:

[HTTPS://DOI.ORG/10.1186/S12711-023-00801-6](https://doi.org/10.1186/S12711-023-00801-6)

THANKS TO ANDREA RAI FOR THE LINGUISTIC REVISION !

