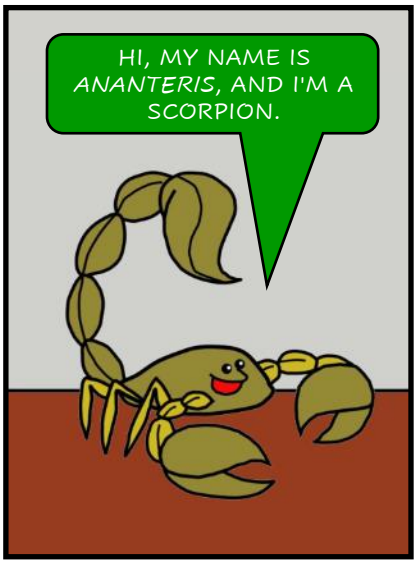
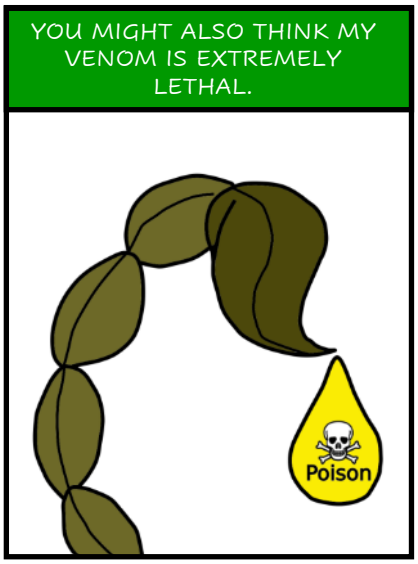
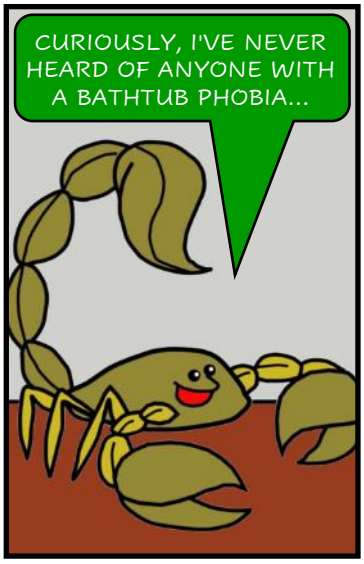
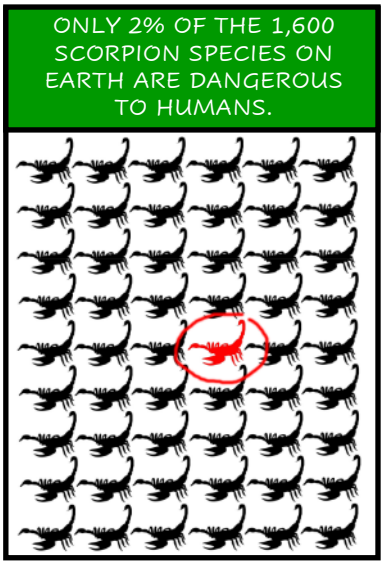
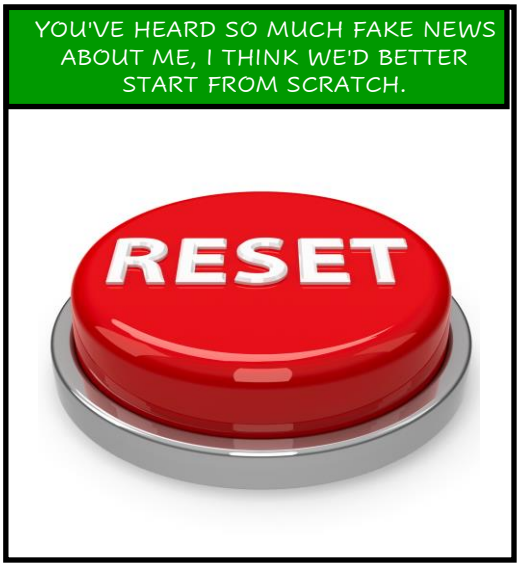
Lose the tail – save the life





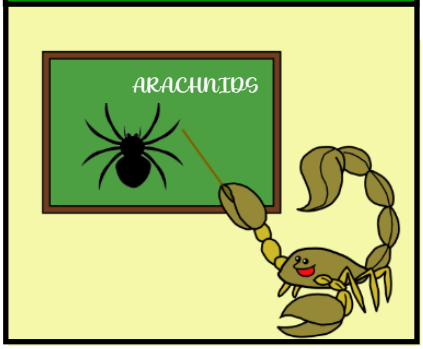




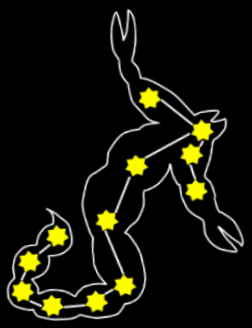


The text of this comic book has been entirely revised and improved with the collaboration of Cara Giaimo, to whom we are very grateful.

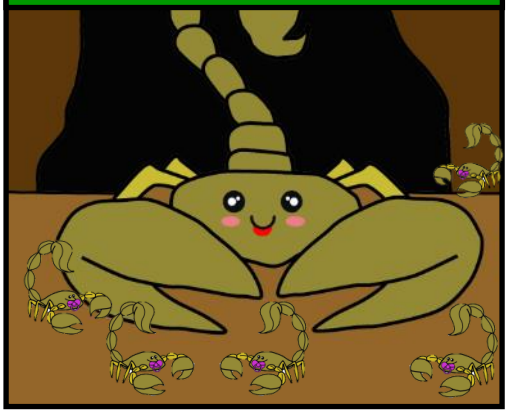
LIKE OTHER ARACHNIDS, SCORPIONS HAVE EIGHT LEGS, TWO MORE THAN INSECTS. WHAT MAKES US UNIQUE AMONG ARACHNIDS ARE OUR CLAWS AND OUR STRONG TAIL.



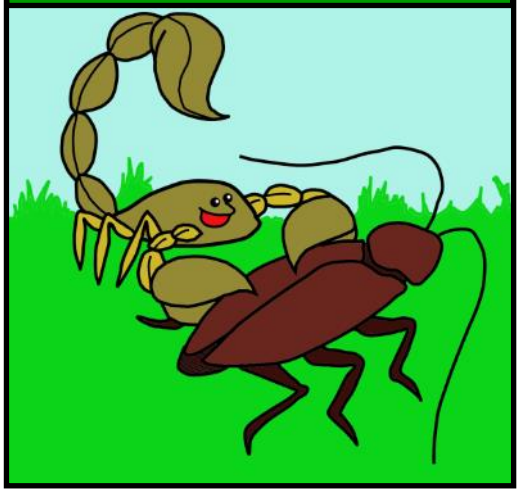
YOU CAN SEE THESE TWO CHARACTERISTICS IN THE CONSTELLATION NAMED AFTER US — SCORPIO.



FEMALES ARE CARING MOTHERS. PREGNANCY CAN LAST MONTHS, AND AFTER BIRTH, FEMALES PROTECT THEIR OFFSPRING FOR SEVERAL WEEKS.

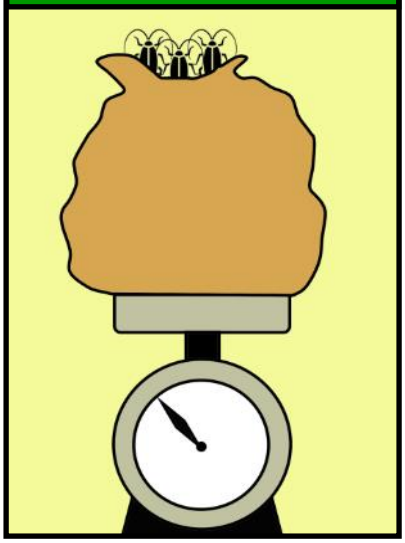


WE USE OUR CLAWS FOR SEVERAL ACTIVITIES, INCLUDING CATCHING SMALL PREY.

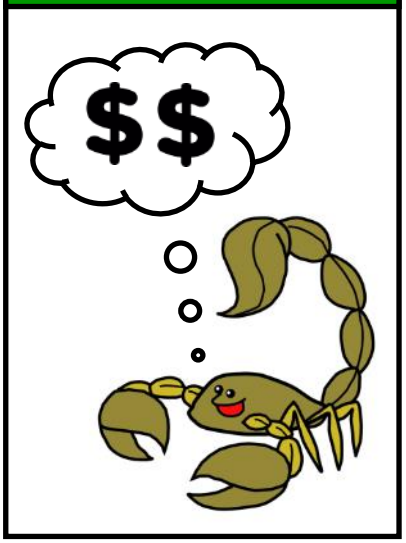


OUR TAIL HAS A STINGER, WHICH WE USE TO INJECT A PARALYZING VENOM INTO LARGE PREY.

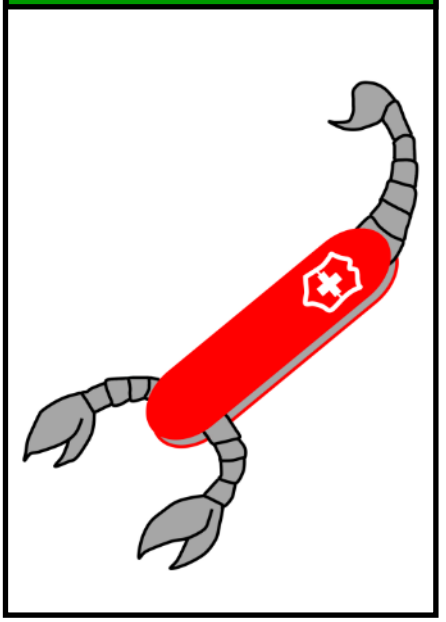
IN 1 YEAR, SCORPIONS CONSUME NEARLY 150 KILOS OF INSECTS PER HECTARE. THAT'S EQUIVALENT TO ALMOST 200,000 COCKROACHES!



MANY OF THE INSECTS WE EAT ARE HARMFUL TO HUMANS — SO REALLY, WE'RE PROVIDING A VALUABLE SERVICE TO YOU FOR FREE.



OUR CLAWS AND OUR TAIL ARE ALSO USEFUL FOR MANY OTHER ASPECTS OF OUR LIVES.



DURING MATING, FOR INSTANCE, MALES, WHICH ARE MUCH SMALLER THAN FEMALES, HOLD THEIR PARTNERS AND PERFORM A COURTSHIP DANCE THAT CAN LAST SEVERAL HOURS.

NEITHER ARGENTINIANS NOR URUGUAYANS INVENTED TANGO. IT WAS THE SCORPIONS!

THE MALE RUBS THE FEMALE'S TAIL WITH HIS OWN, TO SHOW HE WANTS TO MATE WITH HER.

IF SHE AGREES, THE MALE LEAVES A PACKAGE OF SPERM ON THE GROUND. THE FEMALE PICKS IT UP TO FERTILIZE HER EGGS.

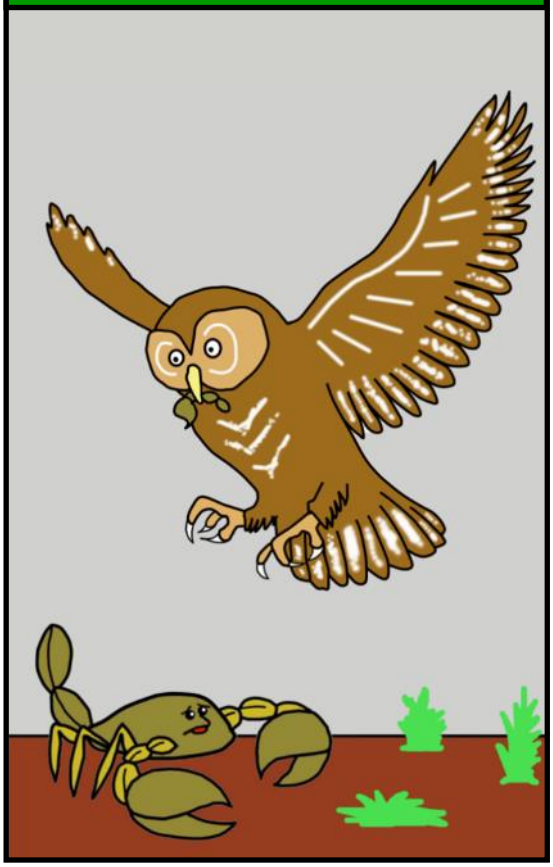
CLAWS ARE ALSO USED FOR DEFENSE. LIKE ALMOST ALL ANIMALS, WE SCORPIONS HAVE PREDATORS. SOME OF THEM CAN BE DETERRED BY A GOOD PINCH!

THE STINGER IN THE TAIL CAN ALSO BE USED FOR DEFENSE. THAT'S WHAT WE DO WHEN A HUMAN STEPS ON US!

DON'T JUDGE US. WE ARE JUST PROTECTING OURSELVES!! NEXT TIME, WEAR SHOES ;)

NOW GET READY, BECAUSE I'M GOING TO TELL YOU ABOUT ANOTHER WAY WE SCORPIONS USE OUR TAILS FOR DEFENSE. THIS ONE REALLY SEEMS TO SURPRISE HUMANS — IN FACT, THEY ONLY JUST LEARNED ABOUT IT.

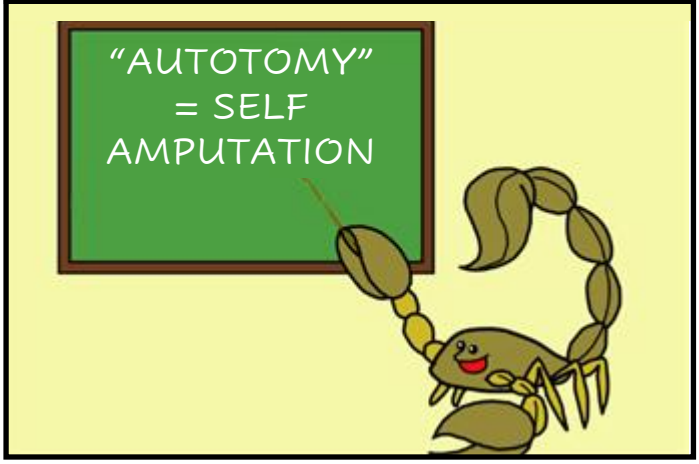
WHEN A PREDATOR GRABS THE TAIL OF AN ANANTERIS, THE SCORPION MAY LET GO OF HIS OWN TAIL TO ESCAPE THE ATTACK ALIVE.



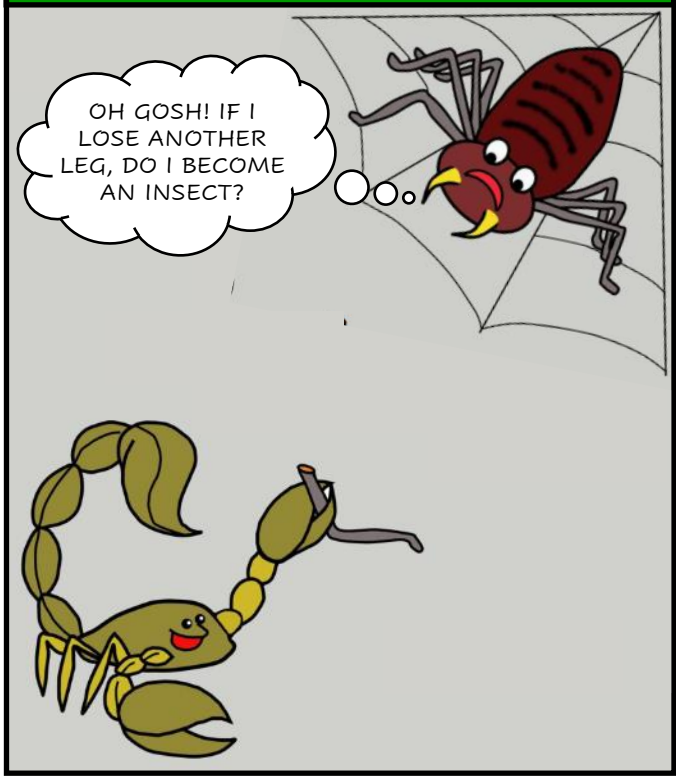
PARENTHESES

I AM NOT PARTICULARLY SHOCKED BECAUSE I ALWAYS KNEW THAT WE *ANANTERIS* COULD DO THIS. HOWEVER, FOR PEOPLE TO KNOW, IT WAS NECESSARY FOR A TEAM OF RESEARCHERS TO MAKE THE DISCOVERY AND TELL THE REST OF THE WORLD.

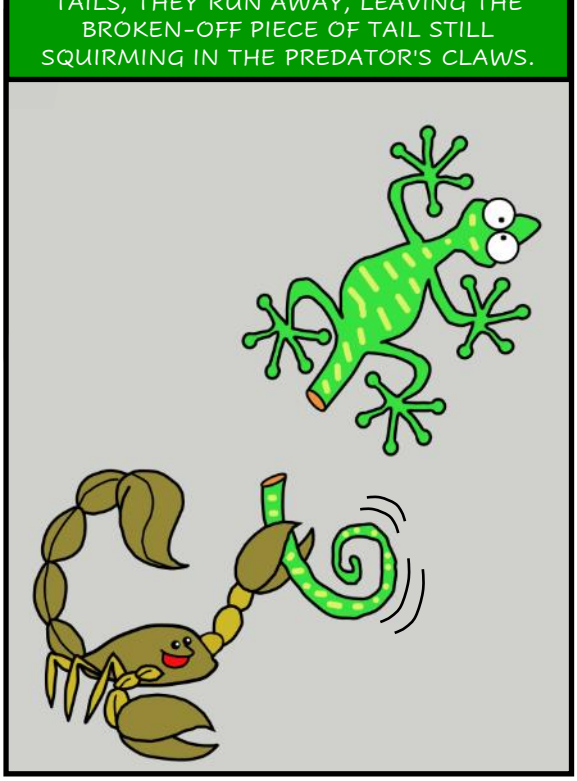
RESEARCHERS CALL THIS "AUTOTOMY" — THE ABILITY TO GET RID OF A BODY PART WHEN GRABBED BY A PREDATOR.



AUTOTOMY OCCURS IN OTHER ARACHNIDS. SPIDERS, FOR EXAMPLE, CAN GET RID OF ONE OR MORE LEGS TO ESCAPE A PREDATOR ATTACK.

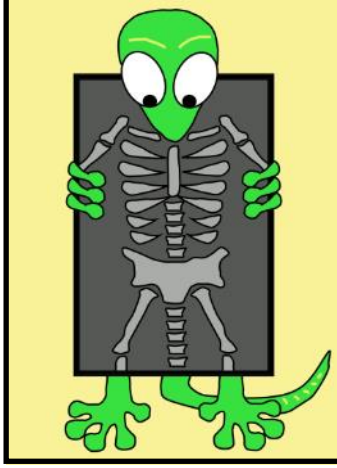


PERHAPS THE MOST FAMOUS CASE OF AUTOTOMY OCCURS IN LIZARDS AND GECKOS. AFTER THEY AMPUTATE THEIR TAILS, THEY RUN AWAY, LEAVING THE BROKEN-OFF PIECE OF TAIL STILL SQUIRMING IN THE PREDATOR'S CLAWS.

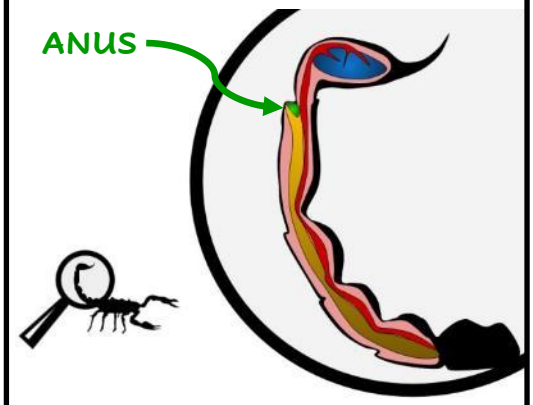


HMM... GECKOS LOSE THEIR TAILS AND SO DO YOU. WHAT MAKES YOU SO SPECIAL?

WELL, A GECKO'S TAIL HAS MOSTLY BONES AND MUSCLES. IT HAS NO IMPORTANT ORGANS.

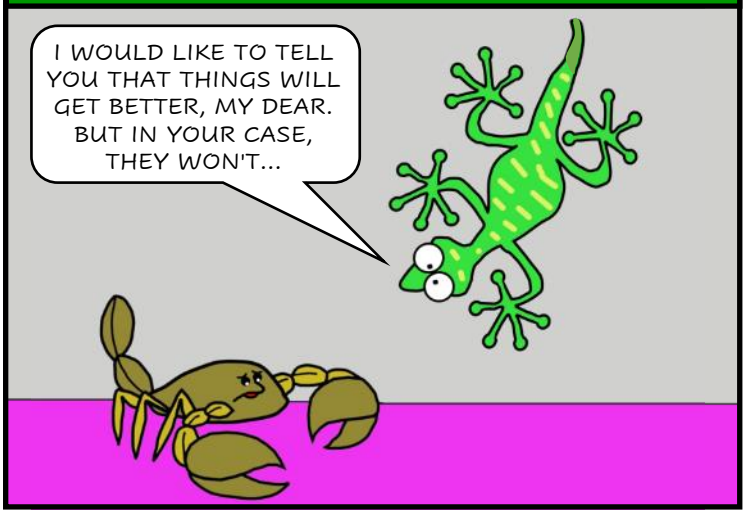


IN SCORPIONS, THE TAIL IS MUCH MORE SOPHISTICATED. INSIDE ARE PARTS OF THE **CIRCULATORY** AND **DIGESTIVE** SYSTEMS, INCLUDING THE **ANUS**. AT THE TIP OF THE TAIL IS THE **VENOM GLAND** AND THE **STINGER**.

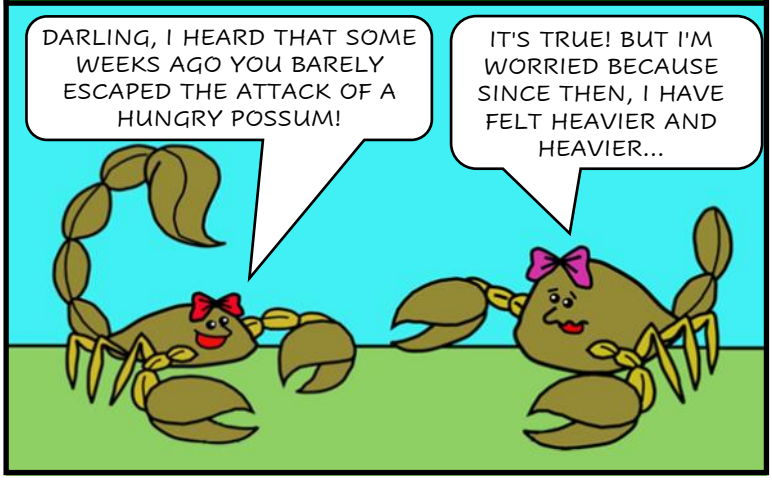


AFTER LOSING THE ANUS, WE GET CONSTIPATED. THIS IS A FREQUENT PROBLEM FOR HUMANS TOO, I'VE HEARD.

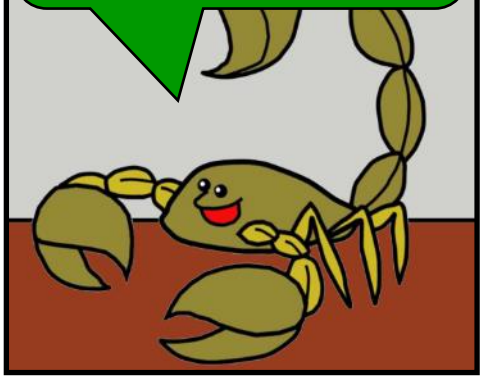
AND UNLIKE WITH GECKOS, OUR TAIL DOESN'T REGENERATE. OUR CONSTIPATION LASTS FOR THE REST OF OUR LIVES.



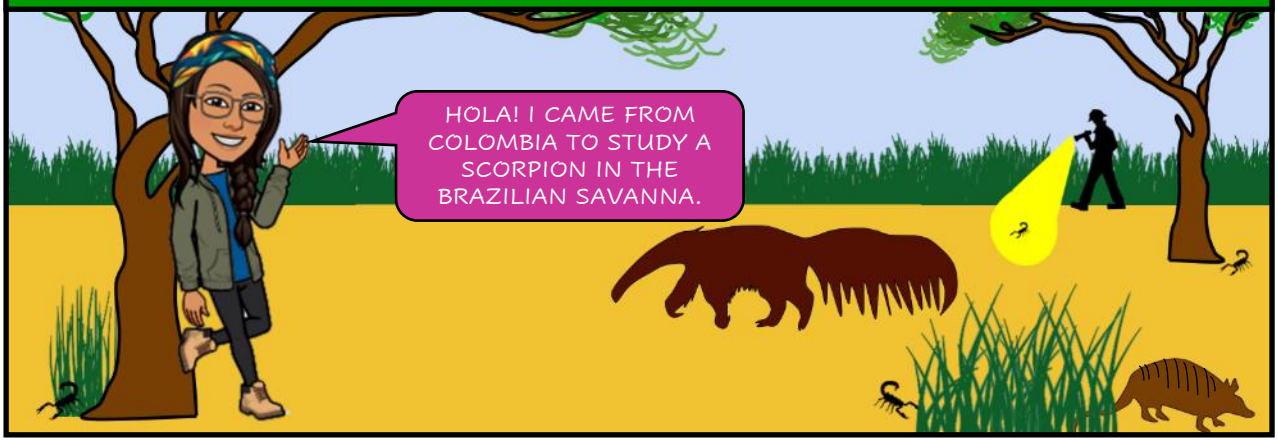
BECAUSE FOOD THAT GOES IN DOESN'T GO OUT, TAIL LOSS PROMOTES WEIGHT GAIN. IN THE LONG TERM, THIS MAY SLOW DOWN THE SCORPION AND LEAD TO DEATH.

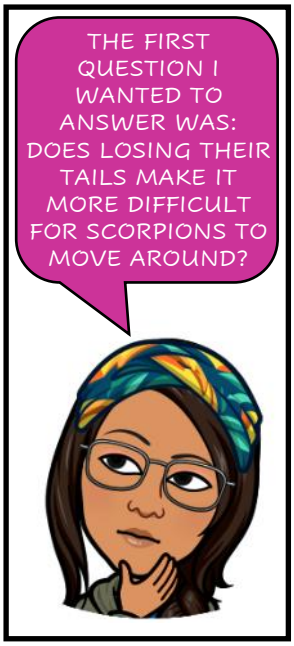


HUMANS KNOW THE IMPORTANCE OF THE TAIL IN A SCORPION'S LIFE. SO, WHEN THEY LEARNED THAT SOME OF US LOSE OUR TAILS, THEY FIGURED WE MIGHT RUN INTO SERIOUS PROBLEMS.

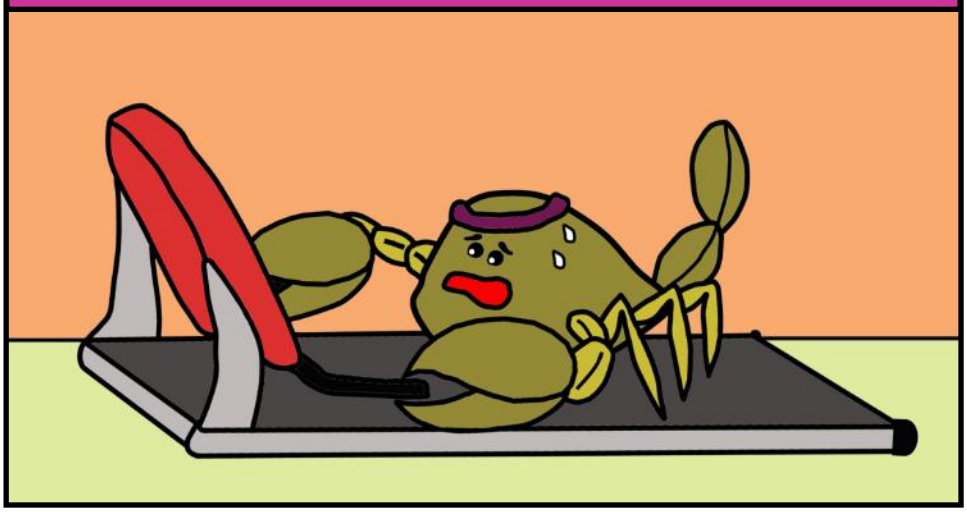


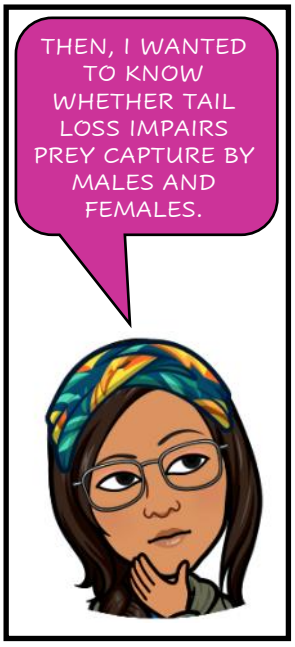
THE PERSON WHO INVESTIGATED THE PROBLEMS THAT COME FROM TAIL LOSS IN SCORPIONS IS NAMED SOLY. SHE IS A DOCTORAL STUDENT IN THE GRADUATE PROGRAM IN ECOLOGY AT THE UNIVERSITY OF SAO PAULO, AND WAS PART OF THE TEAM THAT DISCOVERED AUTOTOMY IN SCORPIONS IN THE FIRST PLACE.



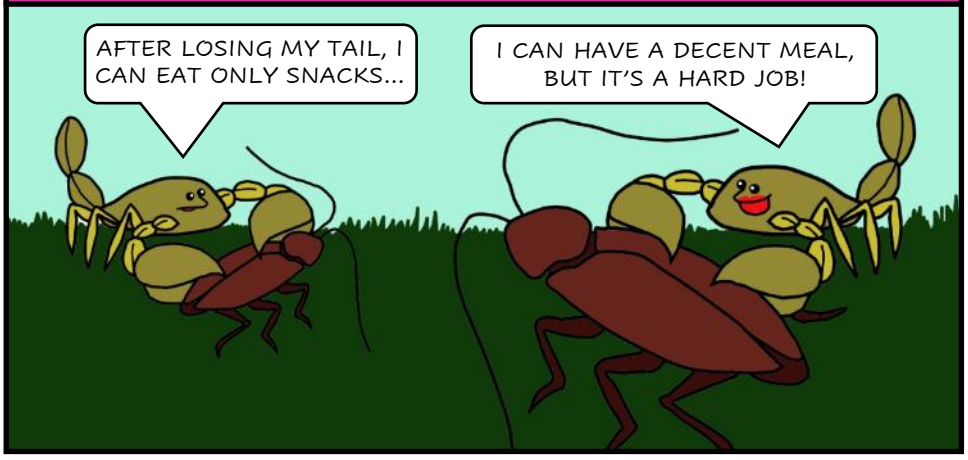


1) I EXPECTED THAT SOON AFTER LOSING THEIR TAILS, SCORPIONS WOULD BE LIGHTER AND RUN FASTER, BECAUSE THEY WOULD BE CARRYING LESS WEIGHT. AFTER A FEW WEEKS, HOWEVER, THEY WOULD BE HEAVIER AND SLOWER, BECAUSE THEY CAN'T DEFECATE.





2) WHEN THEY LOSE THEIR TAILS, SCORPIONS ALSO LOSE THEIR STINGERS, WHICH ARE USED TO CAPTURE LARGE PREY. THEREFORE, MY EXPECTATION WAS THAT AFTER AUTOTOMY, SCORPIONS WOULD ONLY BE ABLE TO EAT PREY SMALL ENOUGH TO BE CAPTURED WITH CLAWS. AND BECAUSE MALES ARE SMALLER THAN FEMALES, I THOUGHT THEY WOULD EAT ONLY VERY SMALL PREY.



LASTLY, I WANTED TO KNOW WHETHER LOSING THE TAIL IMPAIRS REPRODUCTION IN MALES AND FEMALES.

3) I EXPECTED THAT BECAUSE MALES USE THEIR TAILS TO STIMULATE FEMALES DURING THE COURTSHIP DANCE, MALES WITHOUT TAILS WOULD BECOME LESS ATTRACTIVE TO FEMALES. CONSEQUENTLY, THEY WOULD HAVE A LOWER CHANCE OF FINDING A PARTNER TO REPRODUCE WITH.

DUDE, I FEEL I'VE LOST ALL MY CHARM...

IT COULD BE WORSE... IMAGINE IF YOUR GENITALIA WERE ON THE TIP OF YOUR TAIL, AS IN MANY INSECTS!

4) FOR FEMALES, I EXPECTED THAT LOSING THEIR TAILS WOULD LOWER THE AMOUNT OF OFFSPRING. IN A CONSTIPATED FEMALE, THE ABDOMEN IS FILLED WITH FECES, LEAVING LITTLE SPACE FOR BABIES TO DEVELOP.

I'M SEEING IN YOUR MEDICAL RECORD THAT YOU HAD ONLY TEN CHILDREN...

WHEN I DECIDED TO BE A MOTHER, I WAS ALREADY SO CONSTIPATED THAT THERE WAS VERY LITTLE SPACE FOR CHILDREN IN MY LIFE...

TO ANSWER THESE QUESTIONS, SOLY COLLECTED SEVERAL ANANTERIS SCORPIONS IN THE FIELD. SHE USED A BLACKLIGHT TO FIND THEM, BECAUSE SCORPIONS GLOW WHEN YOU SHINE ONE ON US.

IN THE LAB, SOLY SEPARATED THE SCORPIONS INTO TWO TEAMS: TAILED AND TAILLESS.

SHE HAD THE TEAMS COMPETE IN FOUR GAMES:

1) 100 cm dash
(male and female)

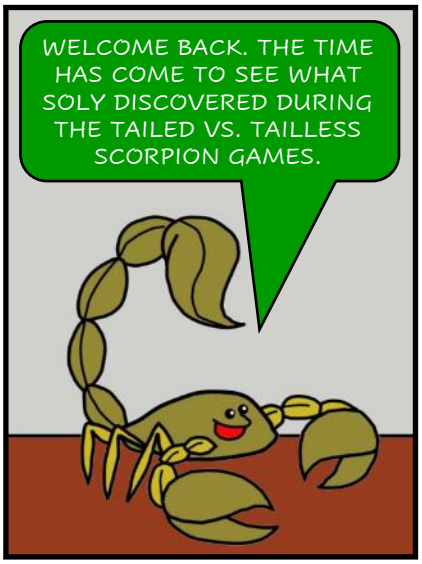
2) Cricket hunting
(male and female)

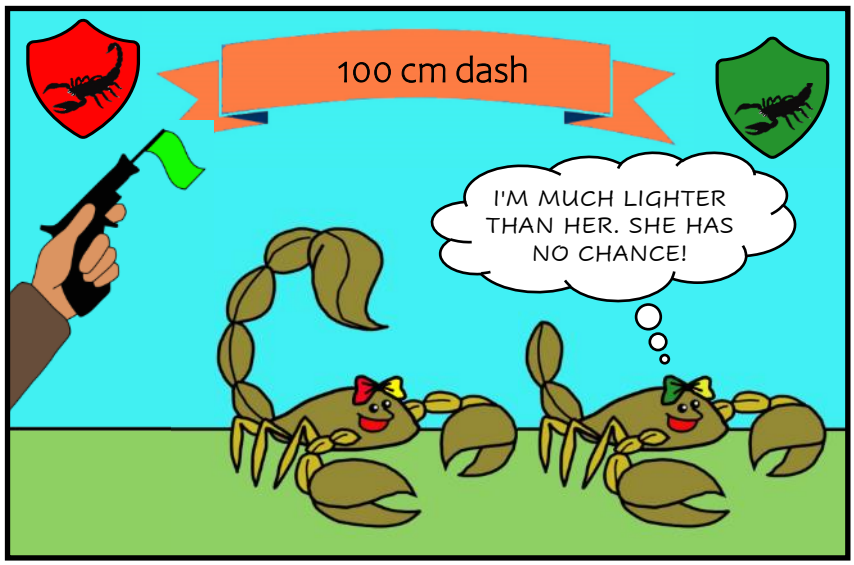
3) Courtship dance
(male)

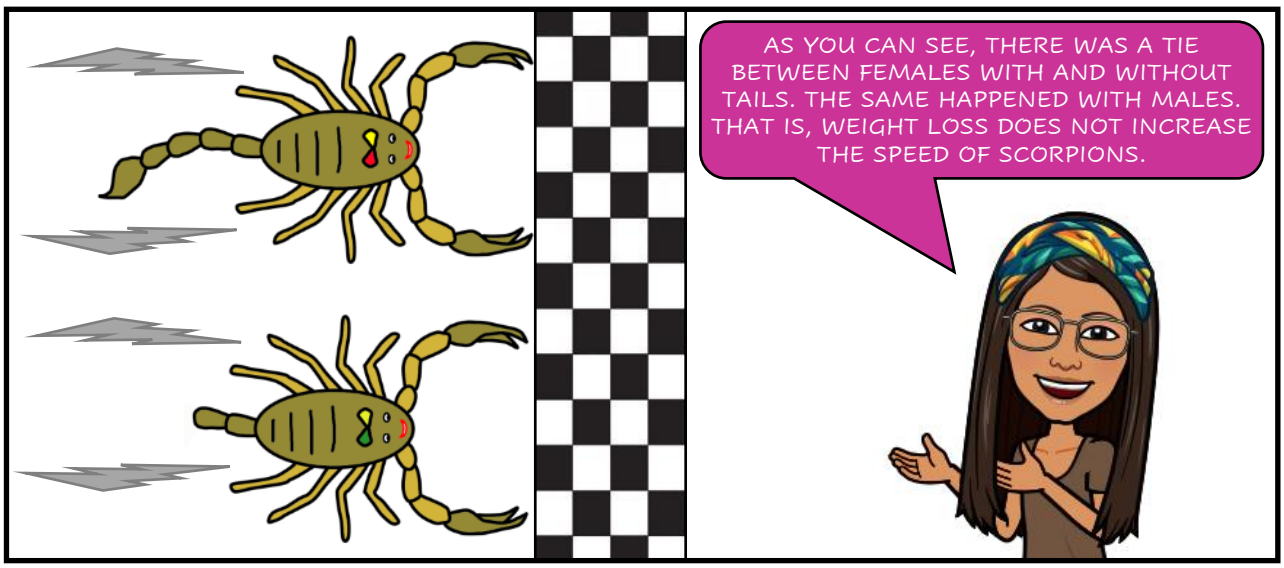
4) Offspring production
(female)

TO FIND OUT WHAT SOLY DISCOVERED, YOU CAN READ THE SCIENTIFIC ARTICLES SHE HAS WRITTEN — OR KEEP READING THIS COMIC!

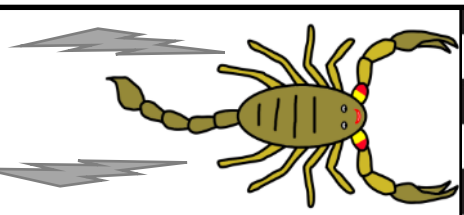
Four years later...

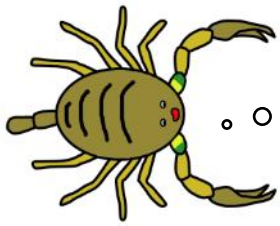






BUT WHAT HAPPENED A FEW WEEKS AFTER TAIL LOSS, WHEN THE SCORPIONS HAD GAINED MASS BECAUSE OF CONSTIPATION?





I SHOULD HAVE EATEN LESS ON THANKSGIVING...

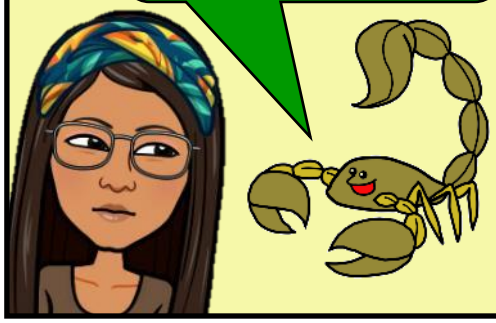
MALES WITHOUT TAILS LOST THE RACE. INDIVIDUALS WITH A TAIL WERE FASTER.

OK, LET'S PAUSE FOR A MOMENT AND REMEMBER SOLY'S EXPECTATIONS. I'M CURIOUS TO KNOW IF THE RESULTS OF THE GAMES WERE WHAT SHE EXPECTED.

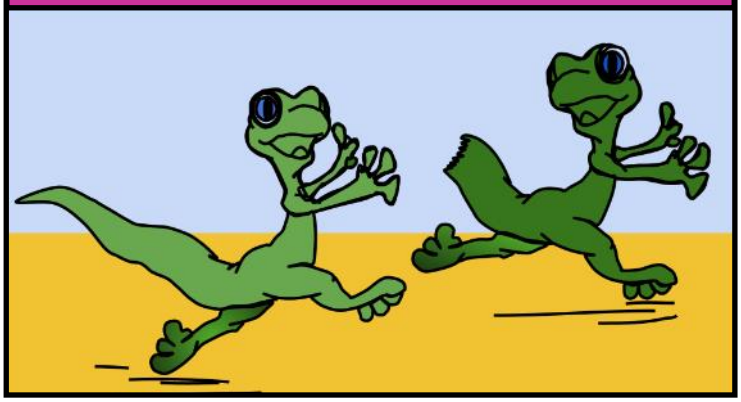
- SOON AFTER LOSING THEIR TAIL, SCORPIONS SHOULD BE LIGHTER AND RUN FASTER

- AFTER A FEW WEEKS, THEY SHOULD GET HEAVER AND RUN SLOWER

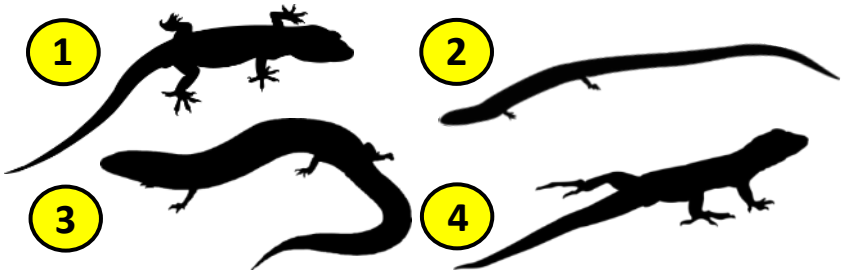
HMM... IT LOOKS LIKE THINGS ARE MORE COMPLICATED THAN YOU EXPECTED. DO YOU HAVE AN EXPLANATION?



FIRST, LET'S SEE WHAT HAPPENS TO LIZARDS IN A SIMILAR SITUATION. A LIZARD WITHOUT A TAIL IS NOT ALWAYS FASTER THAN A LIZARD WITH A TAIL.



TRY TO GUESS WHICH OF THESE LIZARDS ARE FASTER AFTER LOSING THEIR TAIL.

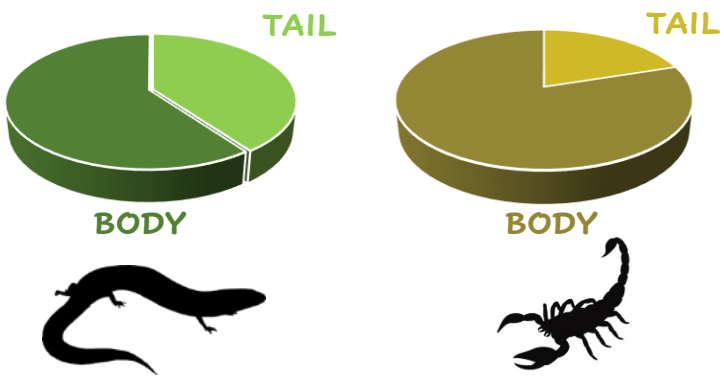


IF YOU ANSWERED 2 OR 3, YOU'RE RIGHT! THE HEAVIER THE TAIL, THE FASTER THE LIZARDS ARE AFTER GETTING RID OF IT.

OK, OK. BUT WHAT DOES ALL THIS HAVE TO DO WITH US SCORPIONS?!

AFTER FOUR YEARS WORKING TOGETHER, PERHAPS WE HAVE GOTTEN TOO CLOSE...

LET ME RETURN TO THE EXPLANATIONS. WHEN COMPARED TO THE TAILS OF LIZARDS 2 AND 3, THE LOST TAIL OF A SCORPION REPRESENTS A MUCH SMALLER PORTION OF THE TOTAL BODY WEIGHT.

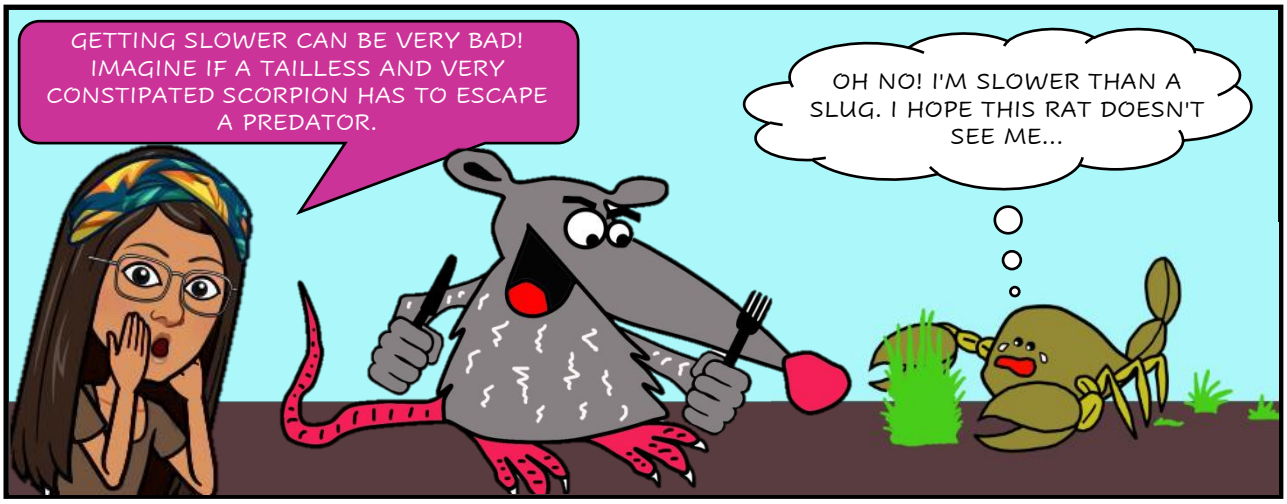


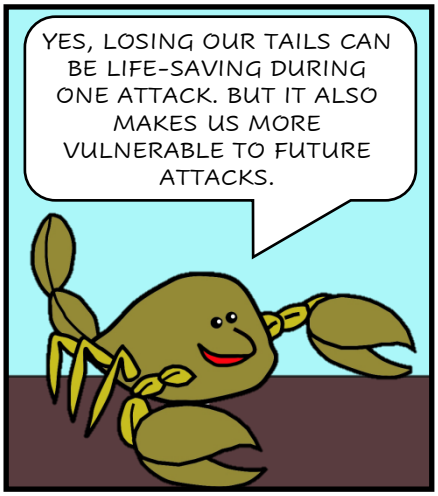
NOW I GET IT! THE LOST TAIL OF A SCORPION IS NOT THAT HEAVY. THAT'S WHY MALES AND FEMALES WITH AND WITHOUT A TAIL WERE TIED IN THE FIRST RACE.

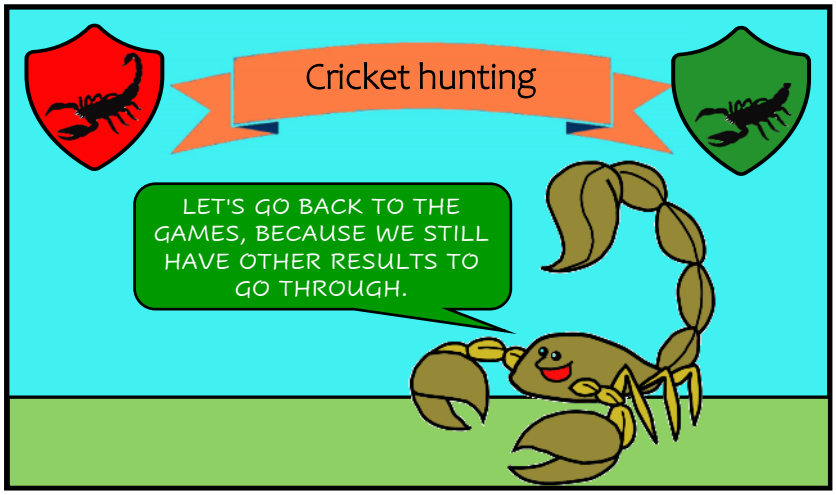
AFTER A FEW WEEKS, THE SCORPIONS ARE VERY CONSTIPATED AND HEAVY. BECAUSE OF THIS, MALES WITHOUT TAILS ARE SLOWER THAN SCORPIONS WITH TALES.

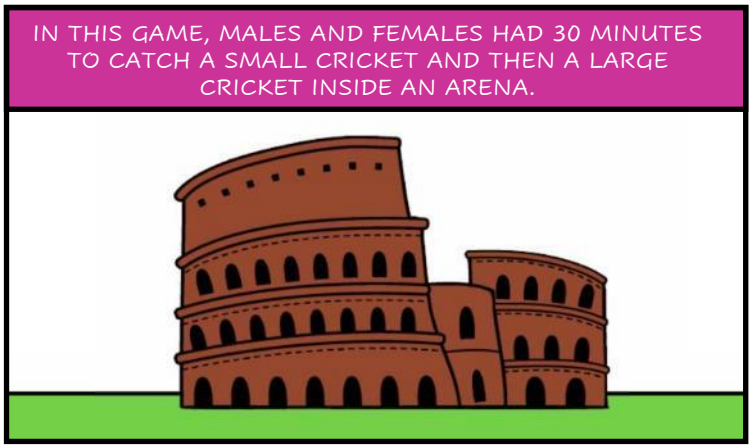
UNFORTUNATELY, THIS IS NOT THE WORLD'S HEAVIEST SCORPION COMPETITION...

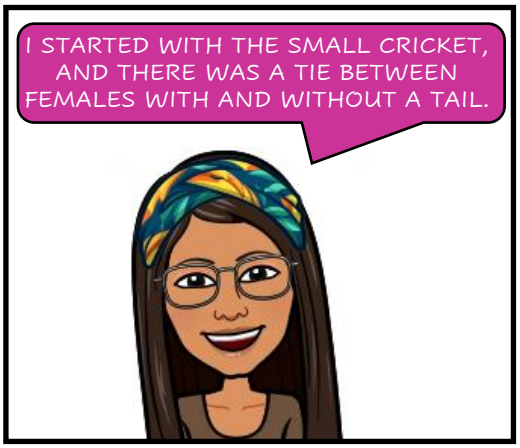
INTERESTING. BUT I WANT TO KNOW WHAT THE CONSEQUENCE OF ALL THIS IS FOR THE POOR SCORPIONS.

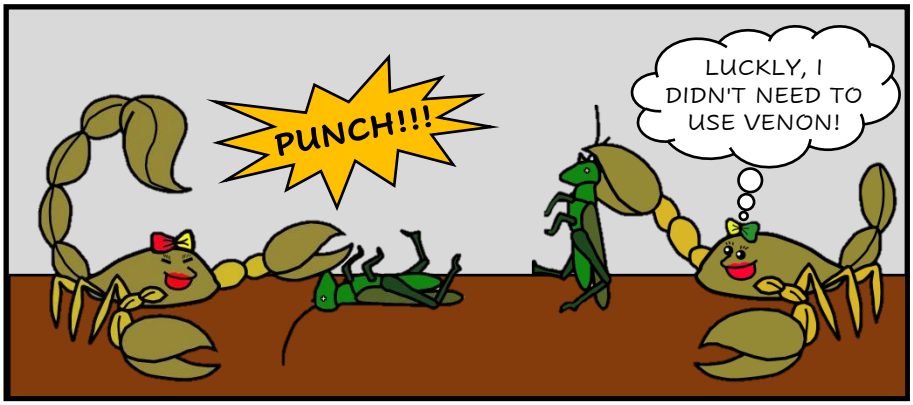

GETTING SLOWER CAN BE VERY BAD! IMAGINE IF A TAILLESS AND VERY CONSTIPATED SCORPION HAS TO ESCAPE A PREDATOR.
OH NO! I'M SLOWER THAN A SLUG. I HOPE THIS RAT DOESN'T SEE ME...

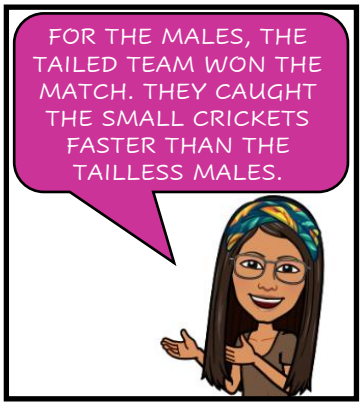

YES, LOSING OUR TAILS CAN BE LIFE-SAVING DURING ONE ATTACK. BUT IT ALSO MAKES US MORE VULNERABLE TO FUTURE ATTACKS.


Cricket hunting
LET'S GO BACK TO THE GAMES, BECAUSE WE STILL HAVE OTHER RESULTS TO GO THROUGH.

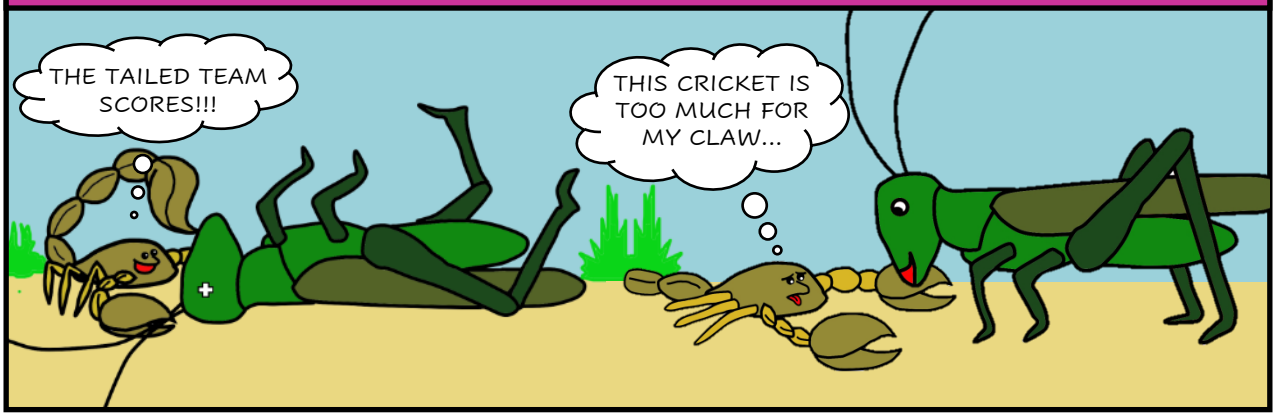

IN THIS GAME, MALES AND FEMALES HAD 30 MINUTES TO CATCH A SMALL CRICKET AND THEN A LARGE CRICKET INSIDE AN ARENA.


I STARTED WITH THE SMALL CRICKET, AND THERE WAS A TIE BETWEEN FEMALES WITH AND WITHOUT A TAIL.

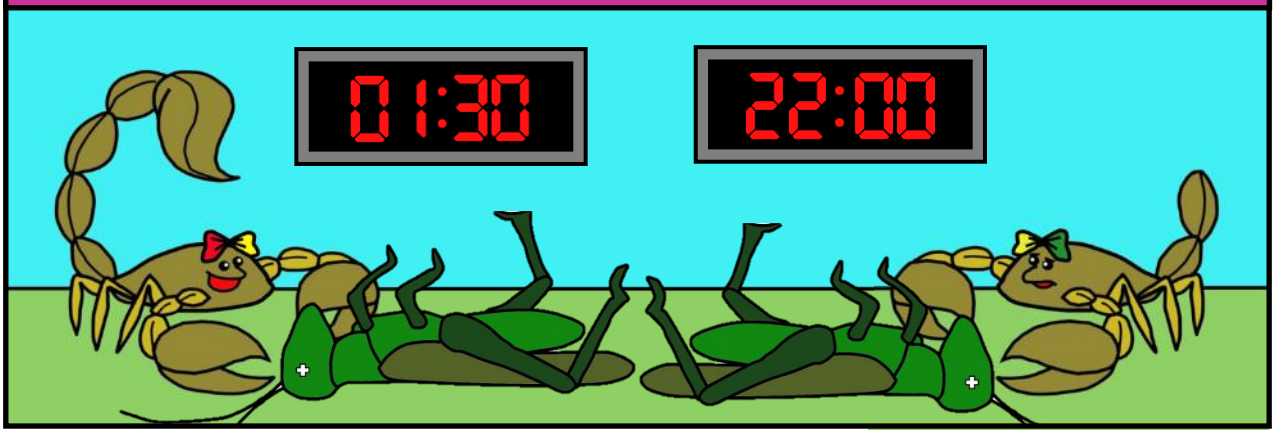

PUNCH!!!
LUCKLY, I DIDN'T NEED TO USE VENON!

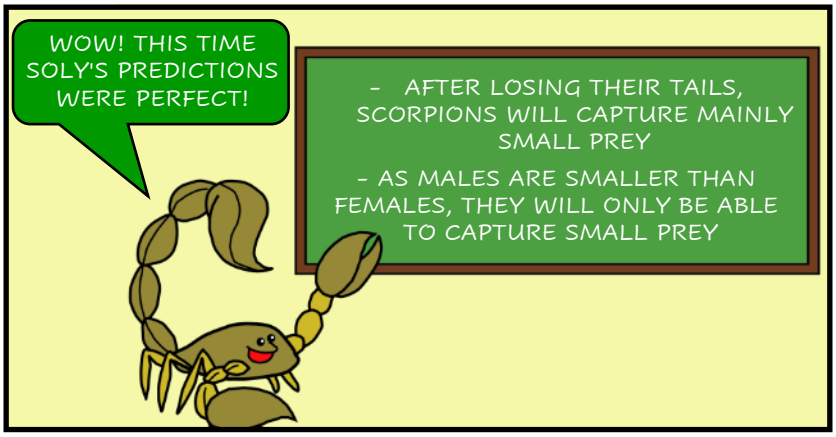

FOR THE MALES, THE TAILED TEAM WON THE MATCH. THEY CAUGHT THE SMALL CRICKETS FASTER THAN THE TAILLESS MALES.

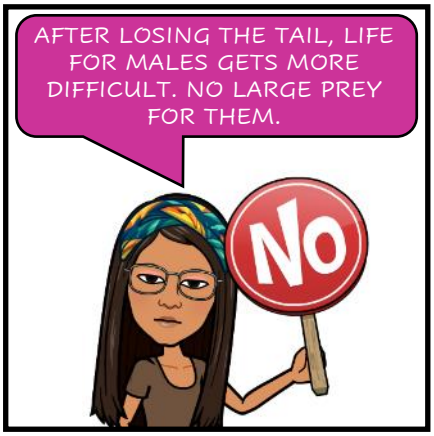
IN THE MATCH WITH A BIG CRICKET, MALES WITH A TAIL WERE ABLE TO USE THEIR VENOM TO KILL AND CAPTURE THE PREY. MALES WITHOUT A TAIL WEREN'T ABLE TO CATCH THE BIG CRICKET AT ALL, EVEN AFTER A LOT OF EFFORT.

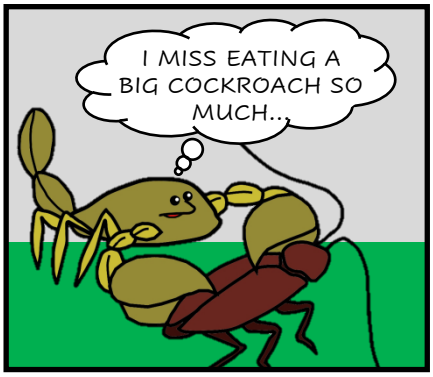


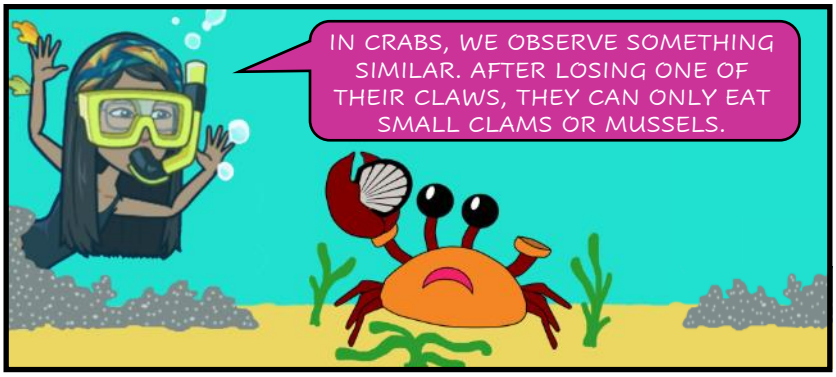
FEMALES WITH AND WITHOUT TAILS MANAGED TO CAPTURE THE BIG CRICKET. HOWEVER, FEMALES WITH TAILS CAUGHT IT MUCH FASTER, SO THEY WON THE MATCH.

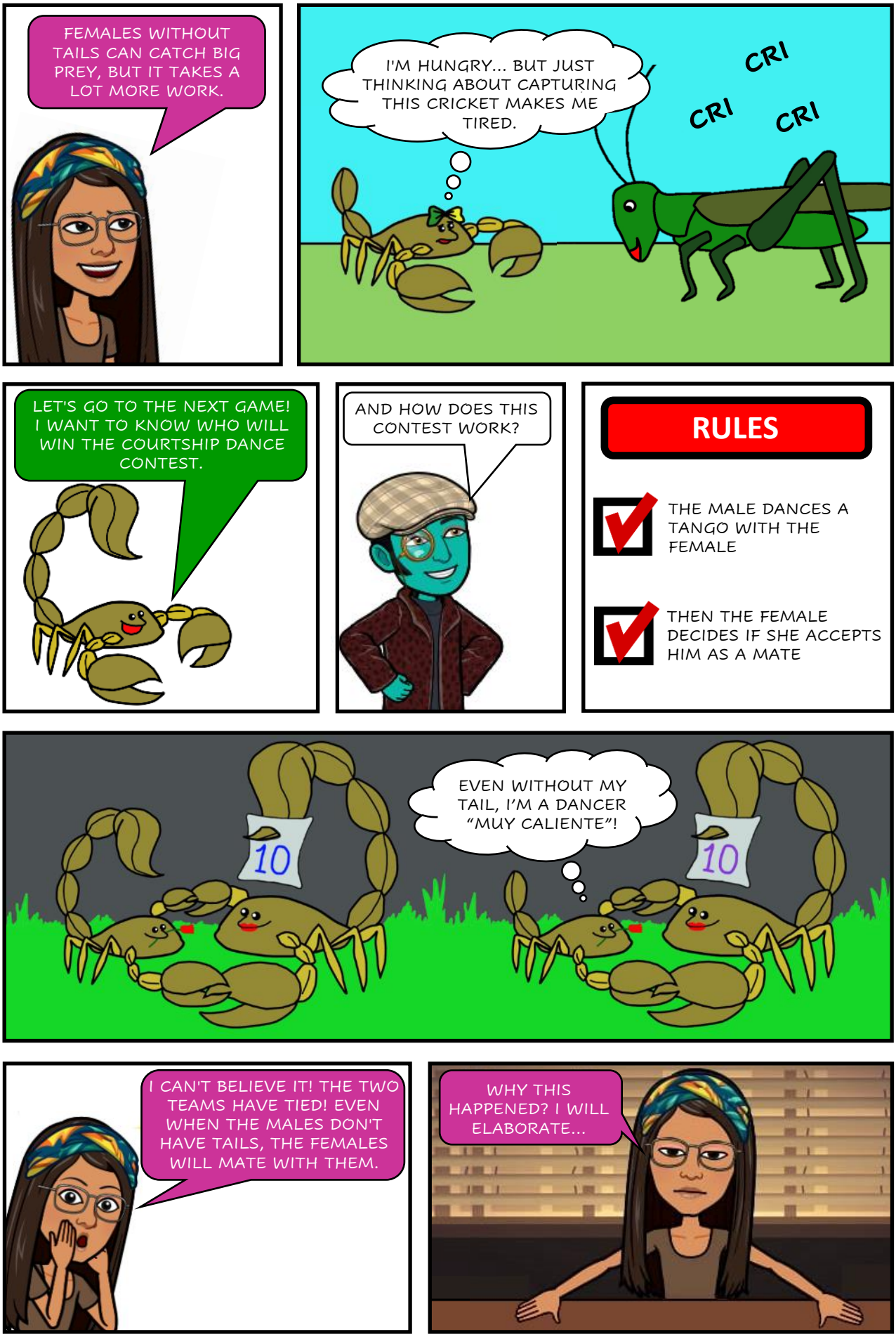




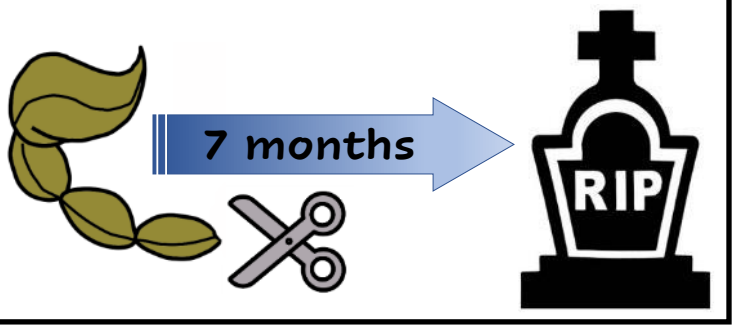


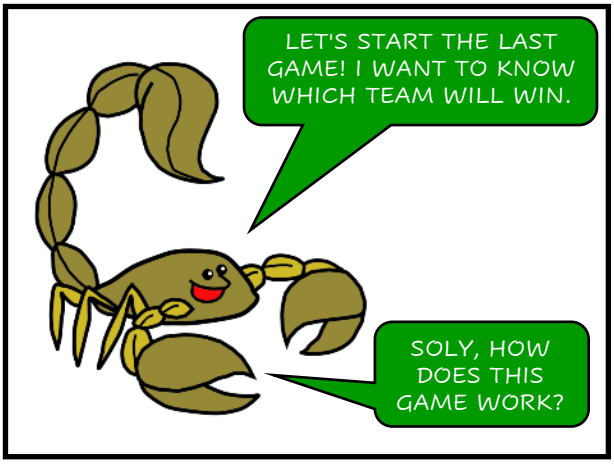


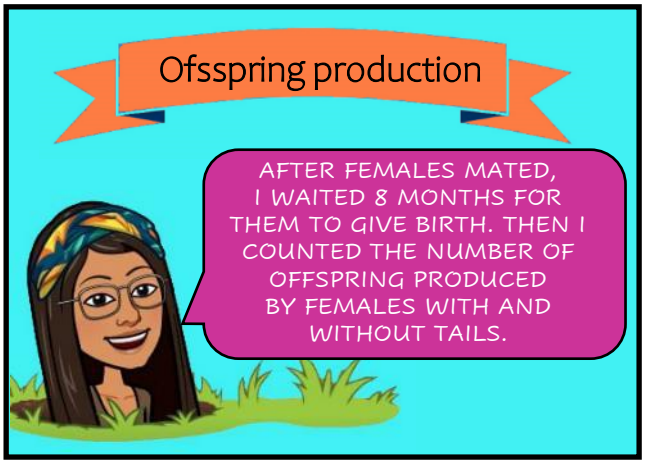


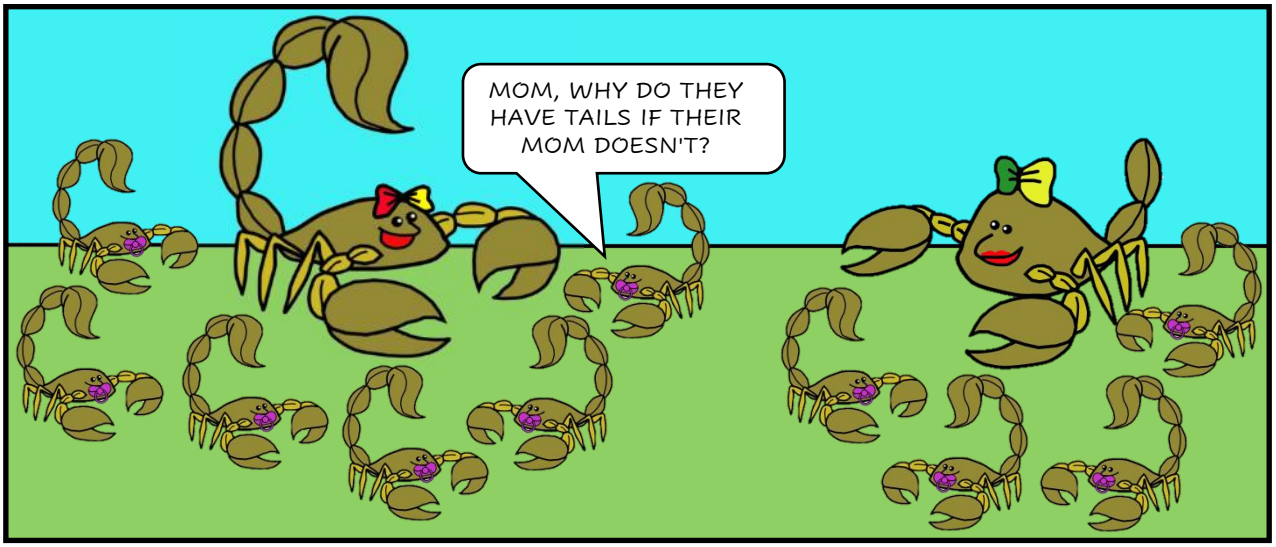

FEMALES WITHOUT TAILS CAN CATCH BIG PREY, BUT IT TAKES A LOT MORE WORK.
I'M HUNGRY... BUT JUST THINKING ABOUT CAPTURING THIS CRICKET MAKES ME TIRED.
CRI
CRI
CRI
LET'S GO TO THE NEXT GAME! I WANT TO KNOW WHO WILL WIN THE COURTSHIP DANCE CONTEST.
AND HOW DOES THIS CONTEST WORK?
RULES
THE MALE DANCES A TANGO WITH THE FEMALE
THEN THE FEMALE DECIDES IF SHE ACCEPTS HIM AS A MATE
10
EVEN WITHOUT MY TAIL, I'M A DANCER "MUY CALIENTE"!
10
I CAN'T BELIEVE IT! THE TWO TEAMS HAVE TIED! EVEN WHEN THE MALES DON'T HAVE TAILS, THE FEMALES WILL MATE WITH THEM.
WHY THIS HAPPENED? I WILL ELABORATE...

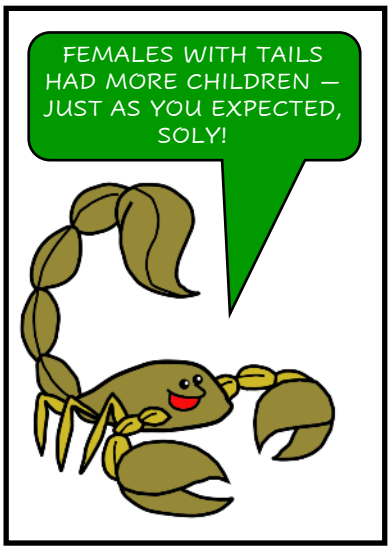
BETWEEN TAIL LOSS AND DEATH FROM CONSTIPATION, A MALE CAN LIVE FOR A WHILE AND MATE SEVERAL TIMES.

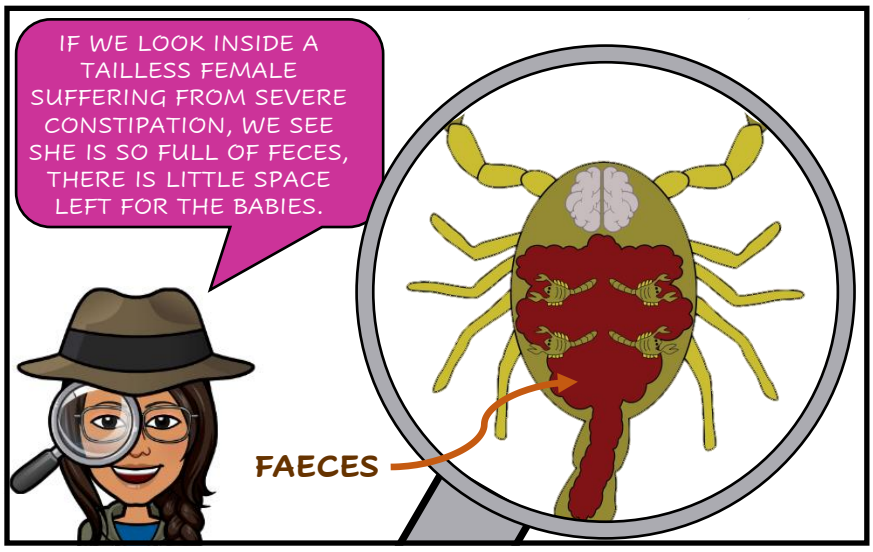




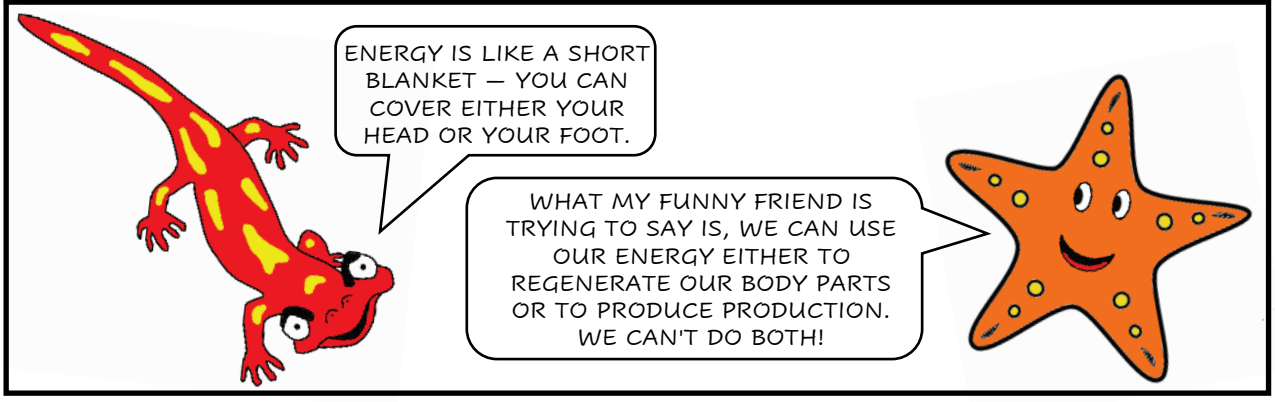


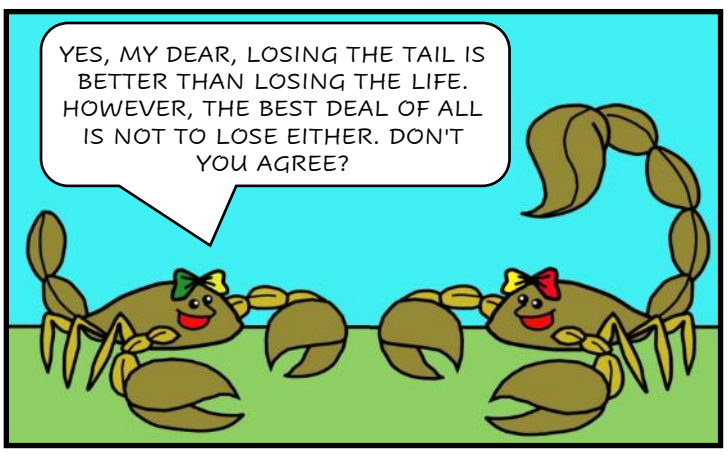


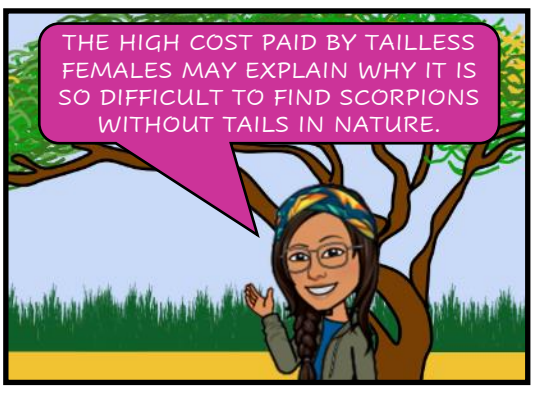




WHEN SALAMANDERS LOSE THEIR TAILS OR STARFISH LOSE THEIR "ARMS," THEY ALSO HAVE FEWER CHILDREN. BUT THE REASON IS TOTALLY DIFFERENT.







1) 100 cm dash: males

WINNER

1) 100 cm dash: females

WINNER

2) Cricket hunting: males

WINNER

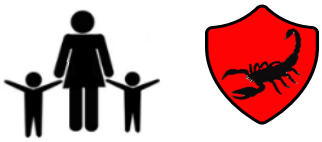
2) Cricket hunting: females

WINNER

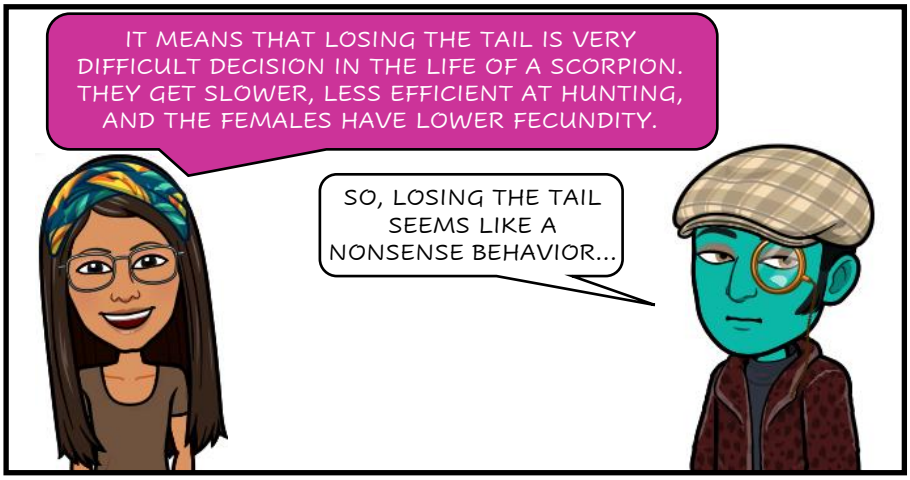
3) Courtship dance

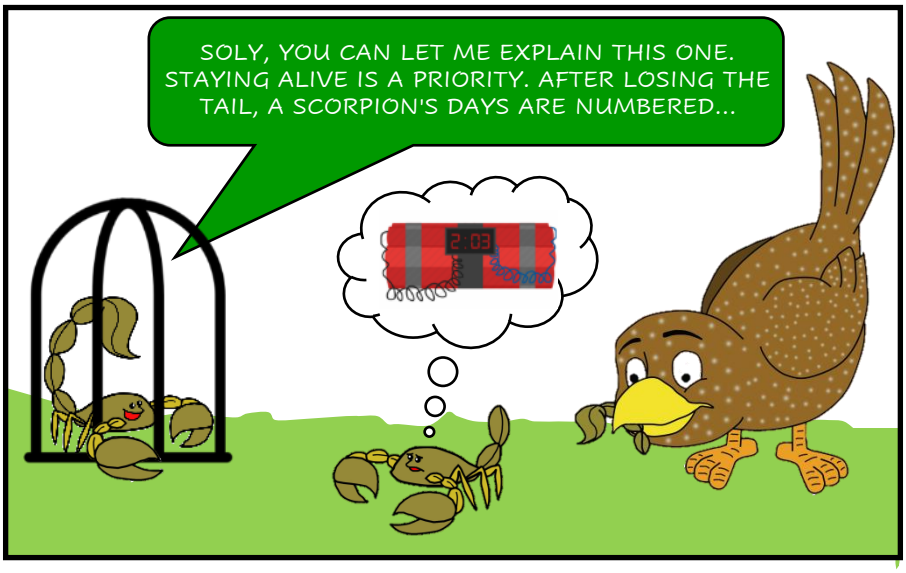
TIED

4) Offspring production

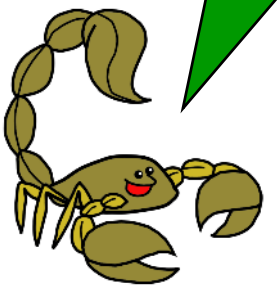


WINNER





BUT BEFORE THEY DIE, THEY STILL HAVE TIME TO REPRODUCE!



THAT'S RIGHT! MALES CAN MATE NORMALLY. AND EVEN IF TAILLESS FEMALES HAVE FEWER CHILDREN, LOSING THE TAIL IS BENEFICIAL, BECAUSE A FEMALE THAT IS EATEN BY A PREDATOR CAN'T HAVE ANY CHILDREN AT ALL.

SO, WE CAN UNDERSTAND HOW TAIL LOSS IN SCORPIONS — WHICH IS ONE OF THE MOST EXTREME FORMS OF DEFENSE IN ANY ANIMAL — MAY HAVE EVOLVED.

Well done, my dear!

WOW, EVERYTHING MAKES SENSE!!!

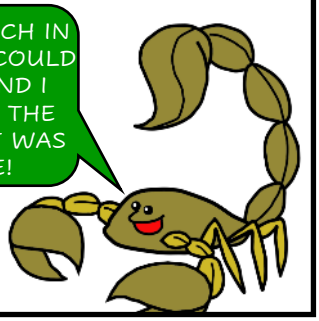
TO FINSISH THIS STORY, I WOULD LIKE TO THANK SOME PEOPLE.

IT'S IMPOSSIBLE TO DO RESEARCH WITHOUT HELP. IN MY CASE, I RECEIVED HELP FROM A LOT OF PEOPLE. I'M VERY GRATEFUL TO EVERYONE.

SPECIAL THANKS TO GLAUCO, MY ADVISOR. HIS HUMOR AND CREATIVITY WERE ESSENTIAL FOR TELLING THIS STORY.

IT'S ALSO IMPOSSIBLE TO DO RESEARCH WITHOUT MONEY. I WANT TO THANK FAPESP AND CAPES FOR THE SCHOLARSHIP I RECEIVED. BOTH OF THEM ARE PUBLIC AGENCIES, THANKS FOR SUPPORTED THIS RESEARCH!

TO EXPLAIN HER RESEARCH IN A WAY THAT EVERYONE COULD UNDERSTAND., SOLY AND I DECIDED TO DO THIS IN THE FORM OF A CARTOON. IT WAS A GOOD ADVENTURE!



FINALLY, YOU CAN'T DO RESEARCH WITHOUT STUDYING A LOT. I'M VERY GRATEFUL TO THE GRADUATE PROGRAM IN ECOLOGY WHERE I DID MY DOCTORATE, AND TO ALL MY LAB MATES, WITH WHOM I LEARNED A LOT OVER FOUR YEARS.

instituto de biociências
USP
Universidade de São Paulo

ECO

LAGE

WE HOPE YOU HAVE ENJOYED THIS STORY.

BYE!

To contact us, please, do not hesitate to write to us: solimarygh@alumni.usp.br & glaucom@ib.usp.br