

LET THE GENES FALL WHERE THEY MAY

WRITTEN BY: JAYSON PAULOSE

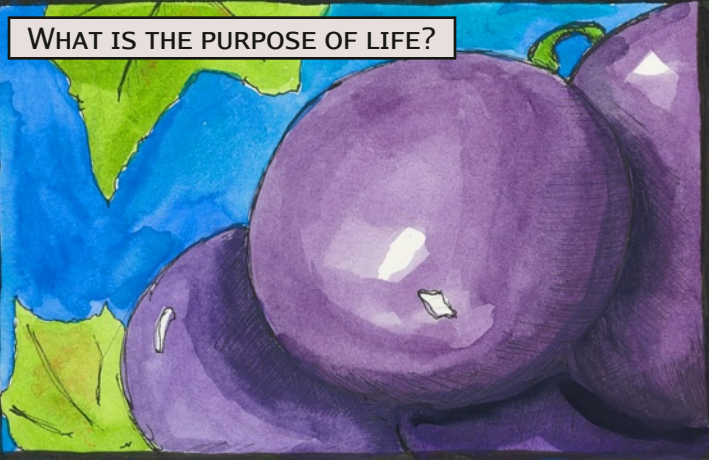
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REFERENCES

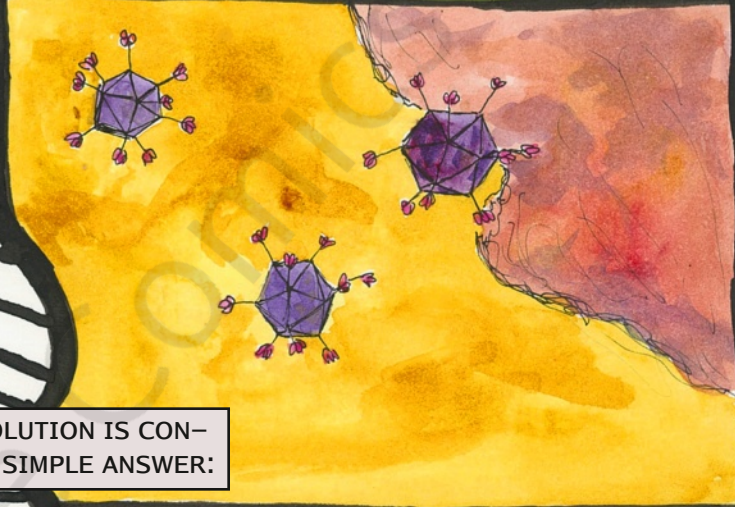
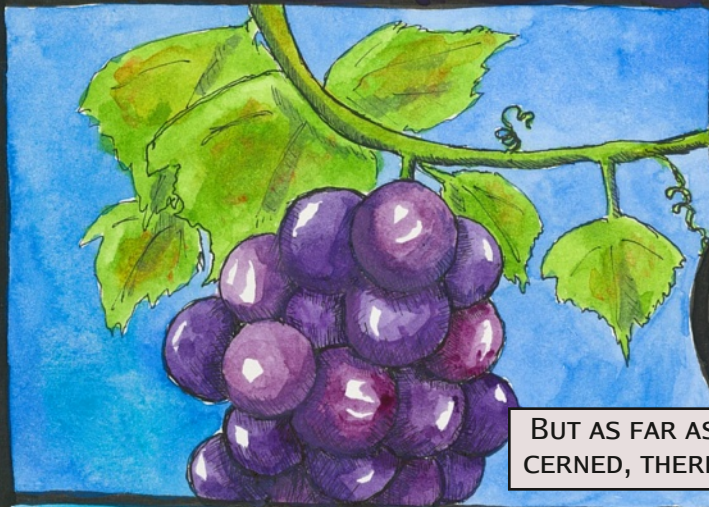
OSKAR HALLATSCHKEK AND DANIEL S FISHER, *ACCELERATION OF EVOLUTIONARY SPREAD BY LONG-RANGE DISPERSAL*. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES VOL. 111, PP. E4911-E4919 (2014)

JAYSON PAULOSE AND OSKAR HALLATSCHKEK, *THE IMPACT OF LONG-RANGE DISPERSAL ON GENE SURFING*. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES VOL. 117, PP. 7584-7593 (2020)

WHAT IS THE PURPOSE OF LIFE?



IT'S A QUESTION THAT HAS STUMPED POETS AND PHILOSOPHERS THROUGH THE AGES.



BUT AS FAR AS EVOLUTION IS CONCERNED, THERE'S A SIMPLE ANSWER:

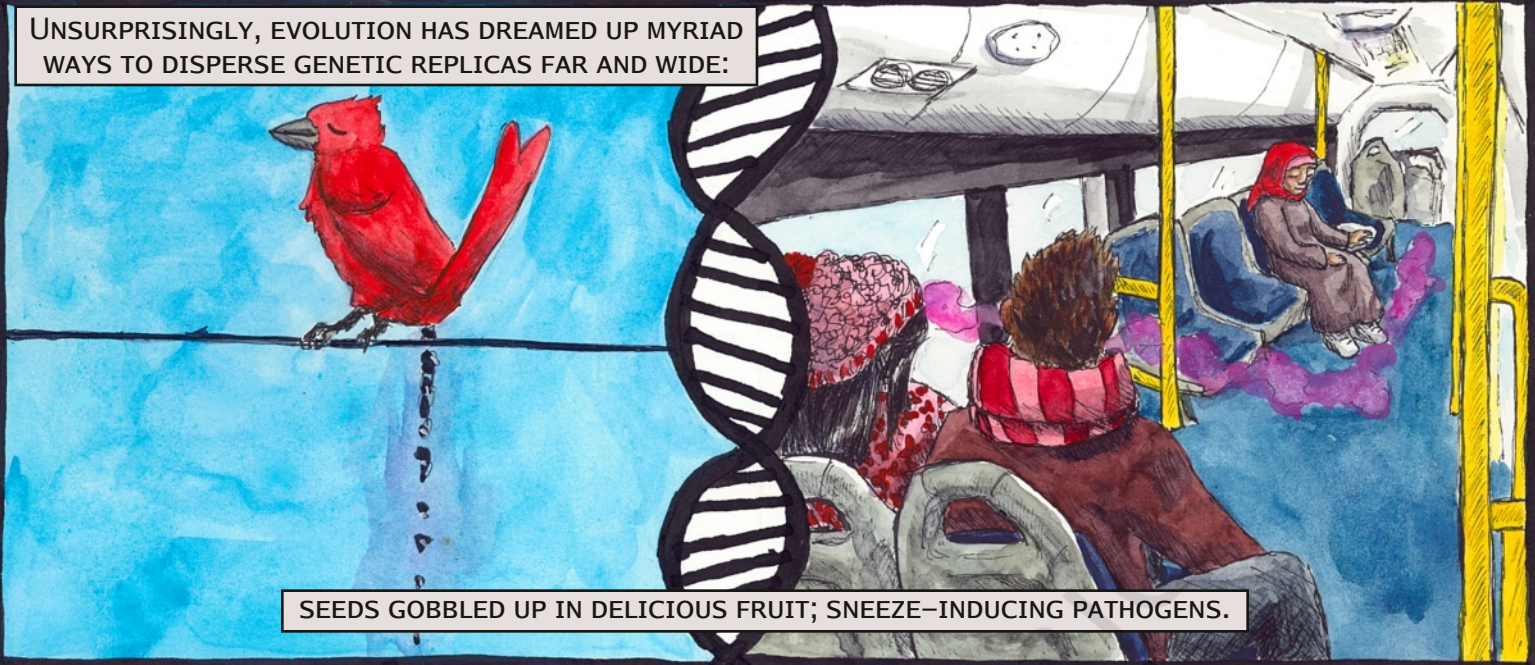


LIVING BEINGS EXIST TO PROPAGATE GENES THROUGH SPACE AND TIME...



...THROUGH WHATEVER MEANS THEY CAN FIND.

UNSURPRISINGLY, EVOLUTION HAS DREAMED UP MYRIAD WAYS TO DISPERSE GENETIC REPLICAS FAR AND WIDE:



SEEDS GOBBLED UP IN DELICIOUS FRUIT; SNEEZE-INDUCING PATHOGENS.

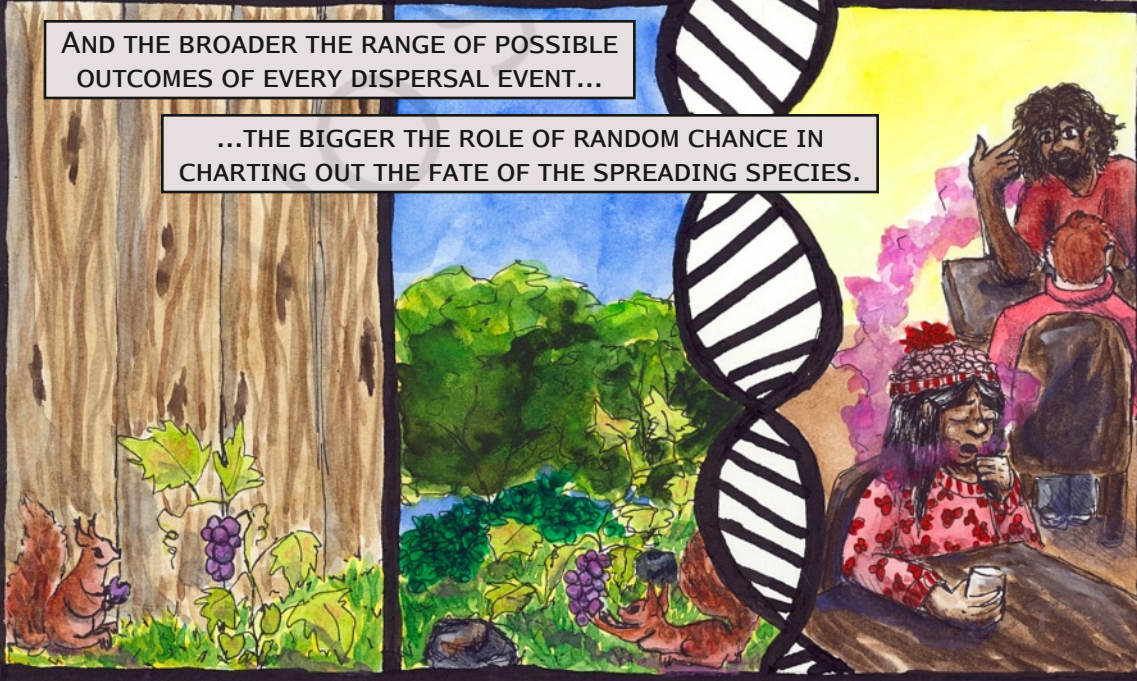
BUT WHERE THE Tanager FLIES, OR THE SICK HOST TRAVELS, IS NOT UP TO THE HITCHHIKER—

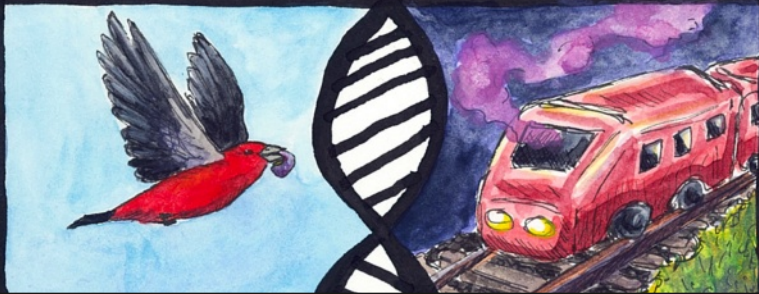


IT IS PURELY A MATTER OF CHANCE.

AND THE BROADER THE RANGE OF POSSIBLE OUTCOMES OF EVERY DISPERSAL EVENT...

...THE BIGGER THE ROLE OF RANDOM CHANCE IN CHARTING OUT THE FATE OF THE SPREADING SPECIES.

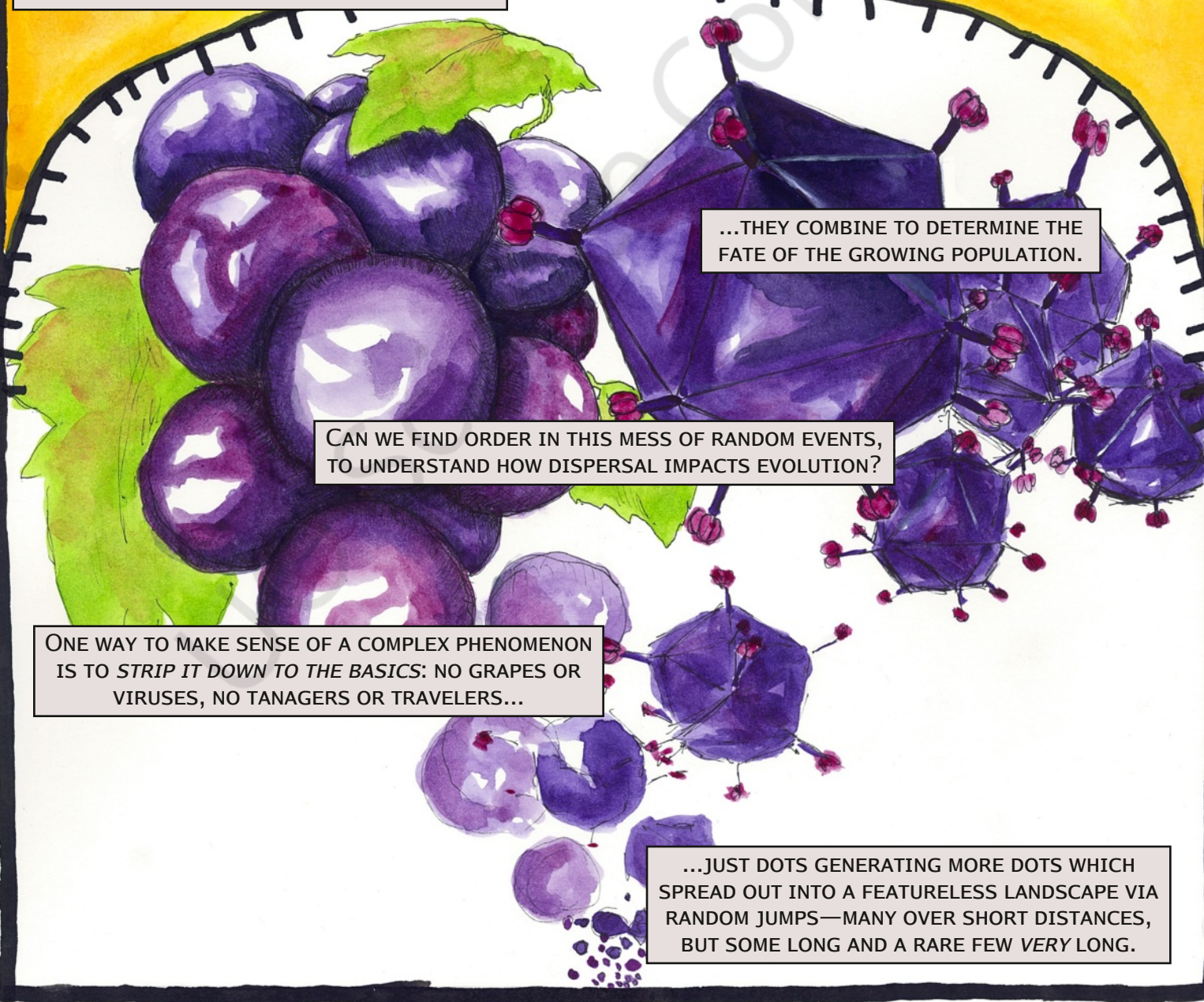




ANY SINGLE DISPERSAL EVENT, ENDING UP IN IN ONE OF MANY POSSIBLE RANDOM OUTCOMES, APPEARS INCONSEQUENTIAL.



YET, AS SCORES OF DISPERSAL EVENTS OCCUR ACROSS GENERATION AFTER GENERATION...

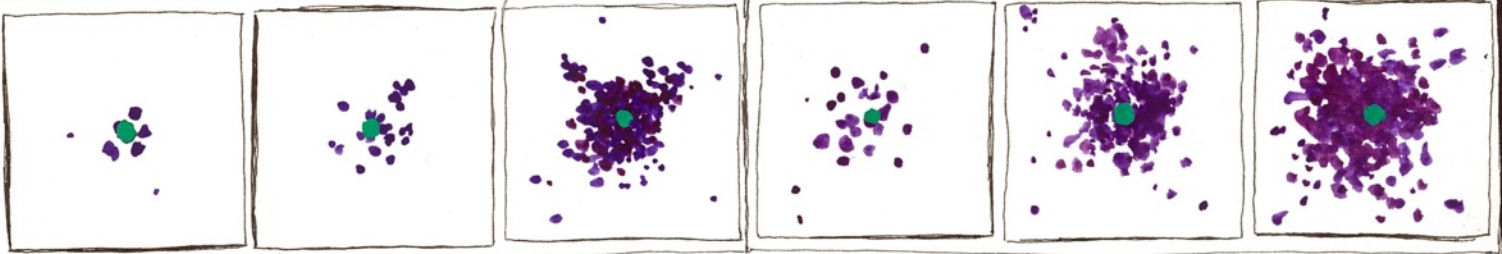


...THEY COMBINE TO DETERMINE THE FATE OF THE GROWING POPULATION.

CAN WE FIND ORDER IN THIS MESS OF RANDOM EVENTS, TO UNDERSTAND HOW DISPERSAL IMPACTS EVOLUTION?

ONE WAY TO MAKE SENSE OF A COMPLEX PHENOMENON IS TO *STRIP IT DOWN TO THE BASICS*: NO GRAPES OR VIRUSES, NO TANAGERS OR TRAVELERS...

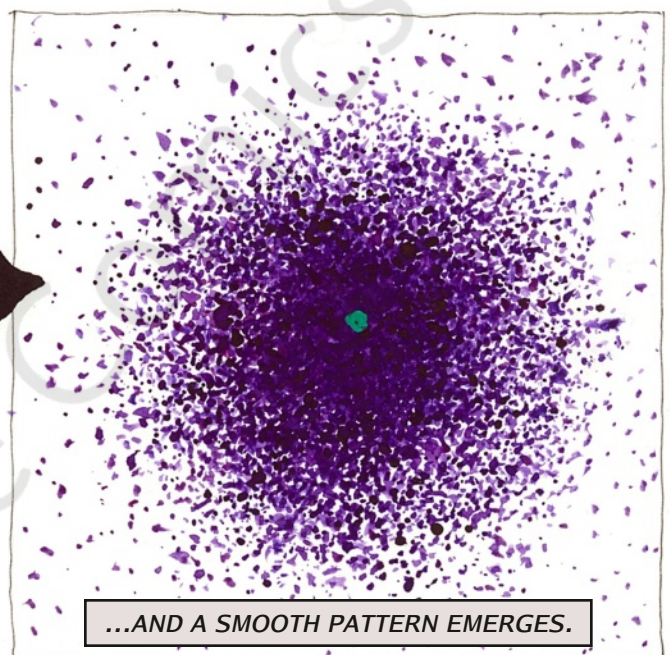
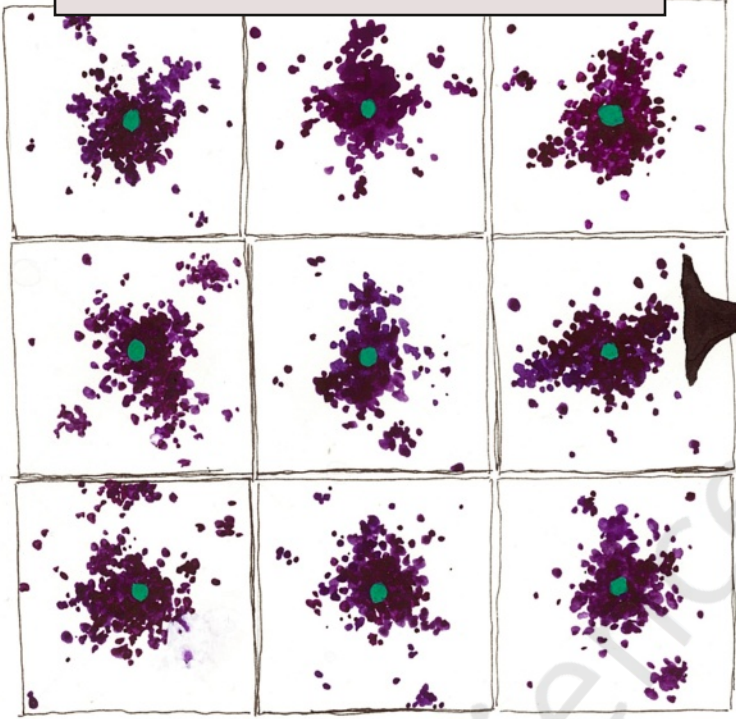
...JUST DOTS GENERATING MORE DOTS WHICH SPREAD OUT INTO A FEATURELESS LANDSCAPE VIA RANDOM JUMPS—MANY OVER SHORT DISTANCES, BUT SOME LONG AND A RARE FEW *VERY* LONG.



TURN THESE BASIC RULES INTO A COMPUTER PROGRAM; LET IT RUN, AND WATCH THE POPULATION OF DOTS EXPAND.

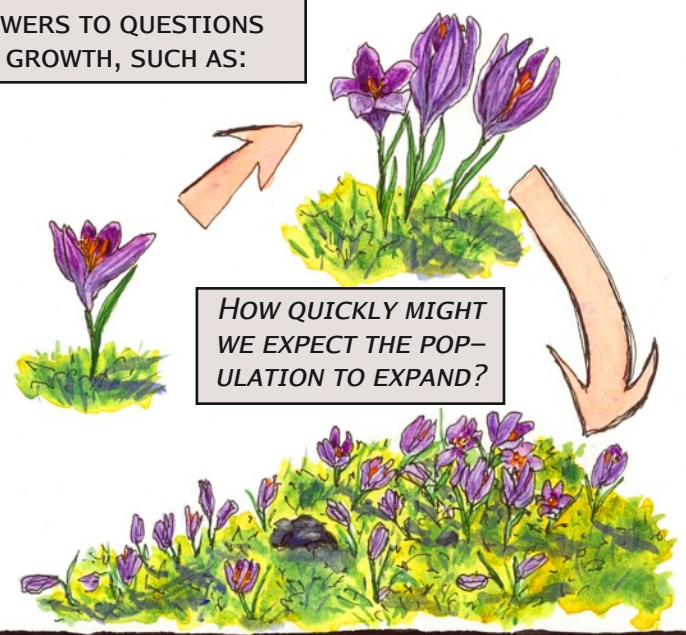
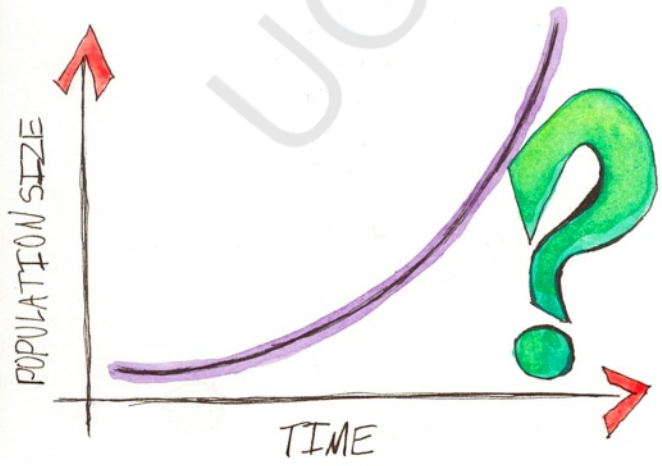
RUN IT AGAIN, AND OBSERVE NEW ROLLS OF THE VIRTUAL DIE COMBINING TO FORM A DIFFERENT SPLATTER OF DOTS.

RUN IT AGAIN, AND AGAIN, AND AGAIN; OVERLAY SCORES OF GENERATED PATTERNS...



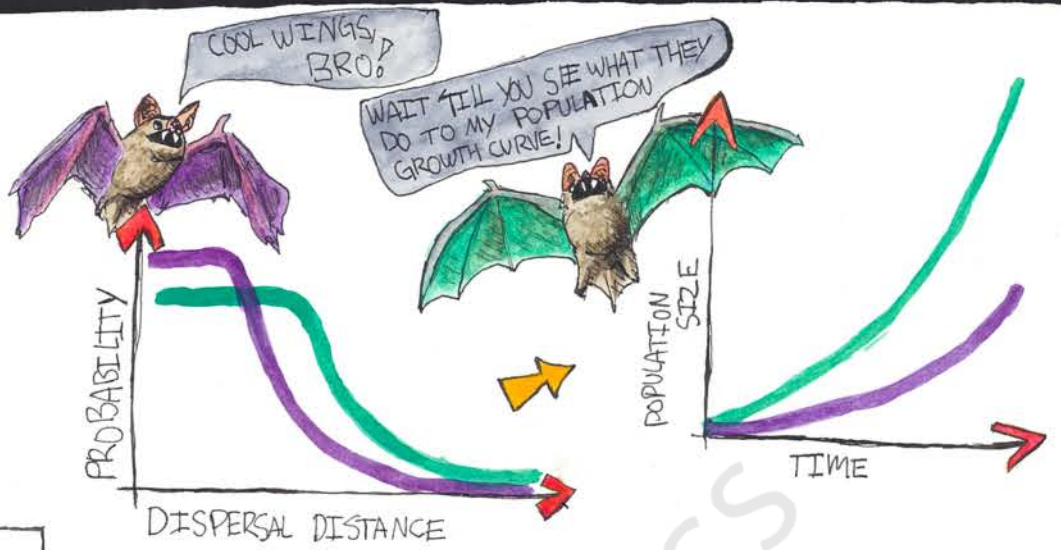
...AND A SMOOTH PATTERN EMERGES.

THE AVERAGE PATTERNS HAVE A SIMPLER STRUCTURE THAN ANY SINGLE OUTCOME OF THE EXPANSION PROCESS, AND PROVIDE ANSWERS TO QUESTIONS ABOUT DISPERSAL-DRIVEN GROWTH, SUCH AS:

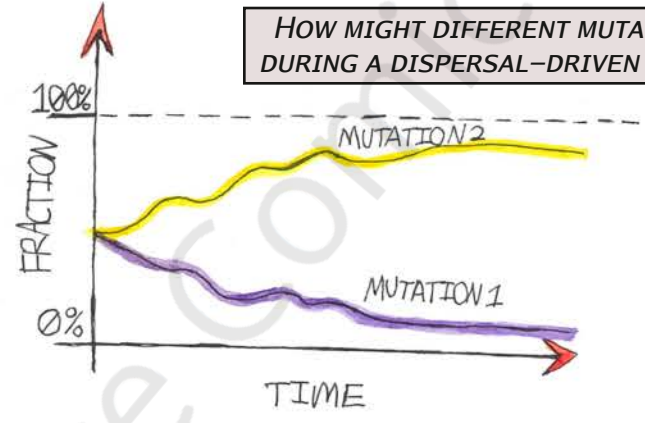


HOW QUICKLY MIGHT WE EXPECT THE POPULATION TO EXPAND?

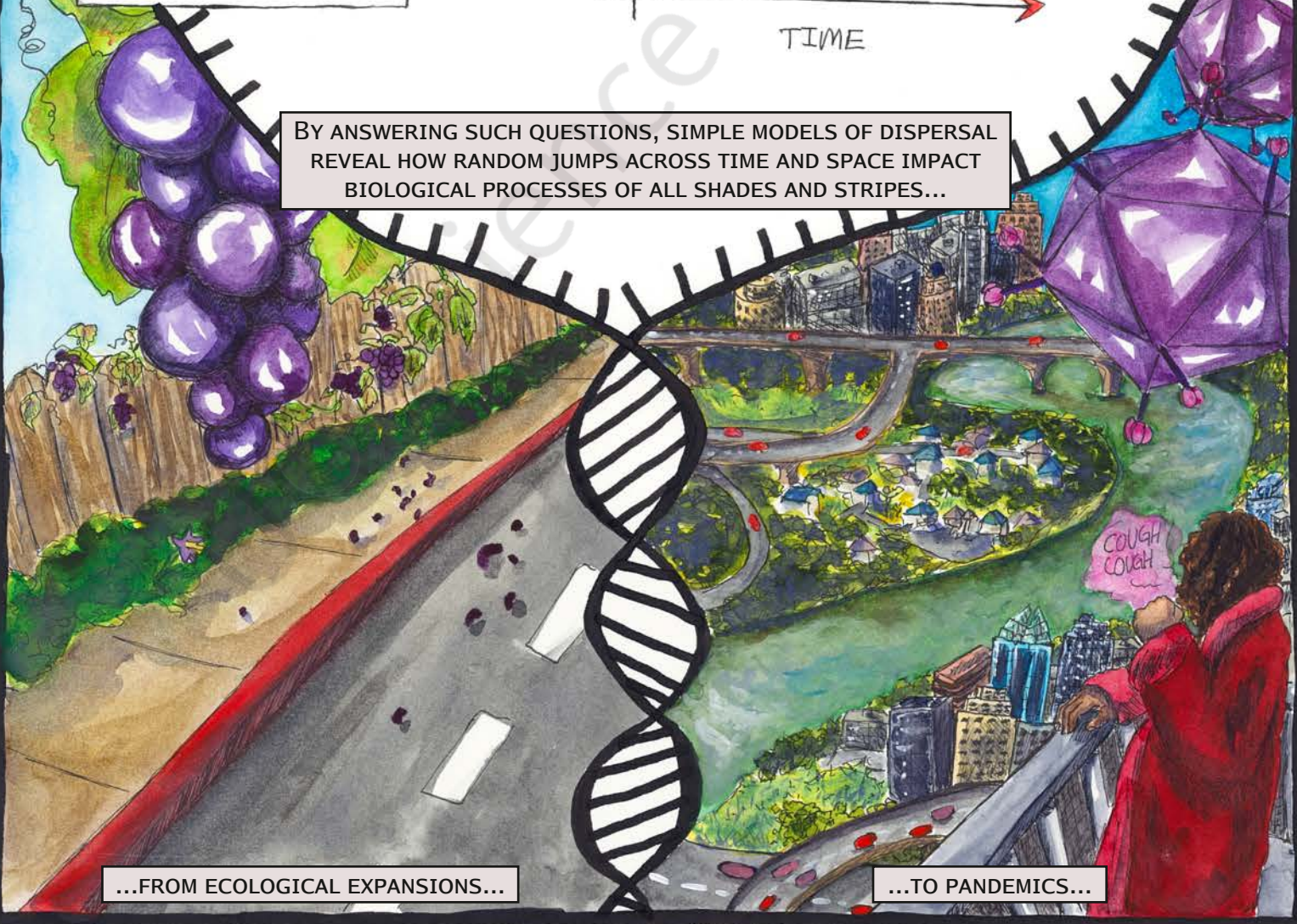
HOW WOULD ALTERING THE ODDS OF TRAVELING NEAR OR FAR AFFECT POPULATION GROWTH?



HOW MIGHT DIFFERENT MUTATIONS FARE DURING A DISPERSAL-DRIVEN EXPANSION?



BY ANSWERING SUCH QUESTIONS, SIMPLE MODELS OF DISPERSAL REVEAL HOW RANDOM JUMPS ACROSS TIME AND SPACE IMPACT BIOLOGICAL PROCESSES OF ALL SHADES AND STRIPES...



...FROM ECOLOGICAL EXPANSIONS...

...TO PANDEMICS...

...TO THE EVOLUTION OF DISPERSAL
ITSELF, IN ITS ABUNDANT FORMS.



Q4A