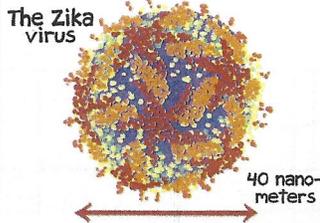


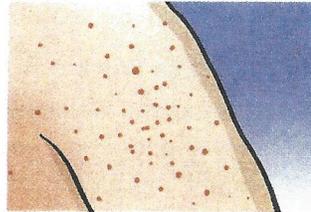
THE ZIKA VIRUS

BY DWAYNE GODWIN
& JORGE CHAM

THE ZIKA VIRUS WAS FIRST DETECTED IN MONKEYS IN THE ZIKA FOREST OF UGANDA IN 1947.



IT WAS INITIALLY CONSIDERED BENIGN. INFECTION IN HUMANS WAS RARE AND ONLY APPEARED TO CAUSE A MILD RASH AND FEVER.



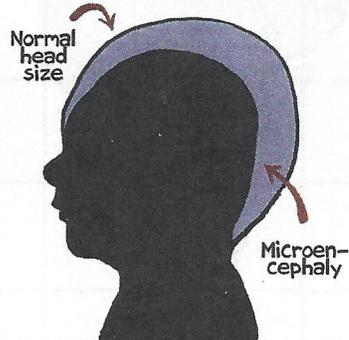
DURING OUTBREAKS IN 2007 AND 2013 IN THE PACIFIC, HEALTH OFFICIALS BEGAN TO SEE A LINK TO CERTAIN NEUROLOGICAL CONDITIONS IN HUMAN PATIENTS.



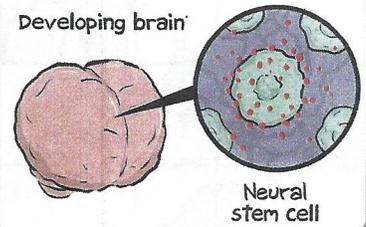
BY 2015 THE DISEASE HAD SPREAD THROUGHOUT ASIA AND SOUTH AMERICA AND IS NOW LINKED TO CASES OF INFANT MICROENCEPHALY.



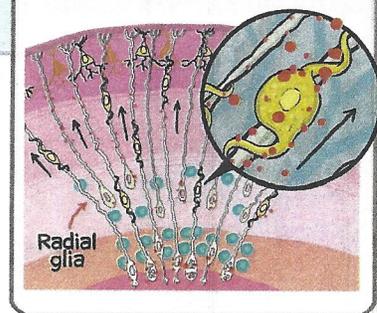
CHILDREN BORN WITH MICROENCEPHALY HAVE A MUCH SMALLER BRAIN AND HEAD. THEY MAY EXPERIENCE SEVERE INTELLECTUAL DISABILITY, SEIZURES AND EVEN DEATH.



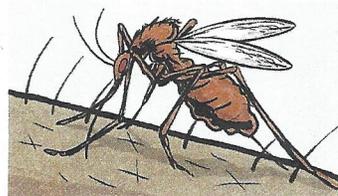
SCIENTISTS BELIEVE THE VIRUS TARGETS A PARTICULAR PROTEIN CALLED AXL, WHICH IS PREVALENT ON THE SURFACE OF NEURAL STEM CELLS.



THE VIRUS KILLS THESE CELLS, AS WELL AS RADIAL GLIAL CELLS, WHICH HELP DEVELOPING NEURONS MIGRATE TO THE OUTER LAYERS OF THE BRAIN.



ZIKA INFECTS 1 IN 5 PEOPLE EXPOSED TO THE VIRUS AND CAN BE TRANSMITTED BY MOSQUITOES, BLOOD TRANSFUSIONS, SEXUAL CONTACT OR FROM MOTHERS TO THEIR FETUSES.



HEALTH OFFICIALS ARE URGING RESIDENTS AND TRAVELERS IN ZIKA-PRONE AREAS TO TAKE SPECIAL PRECAUTIONS.

BECAUSE THE BEST WAY TO STOP THE SPREAD OF A VIRUS ...



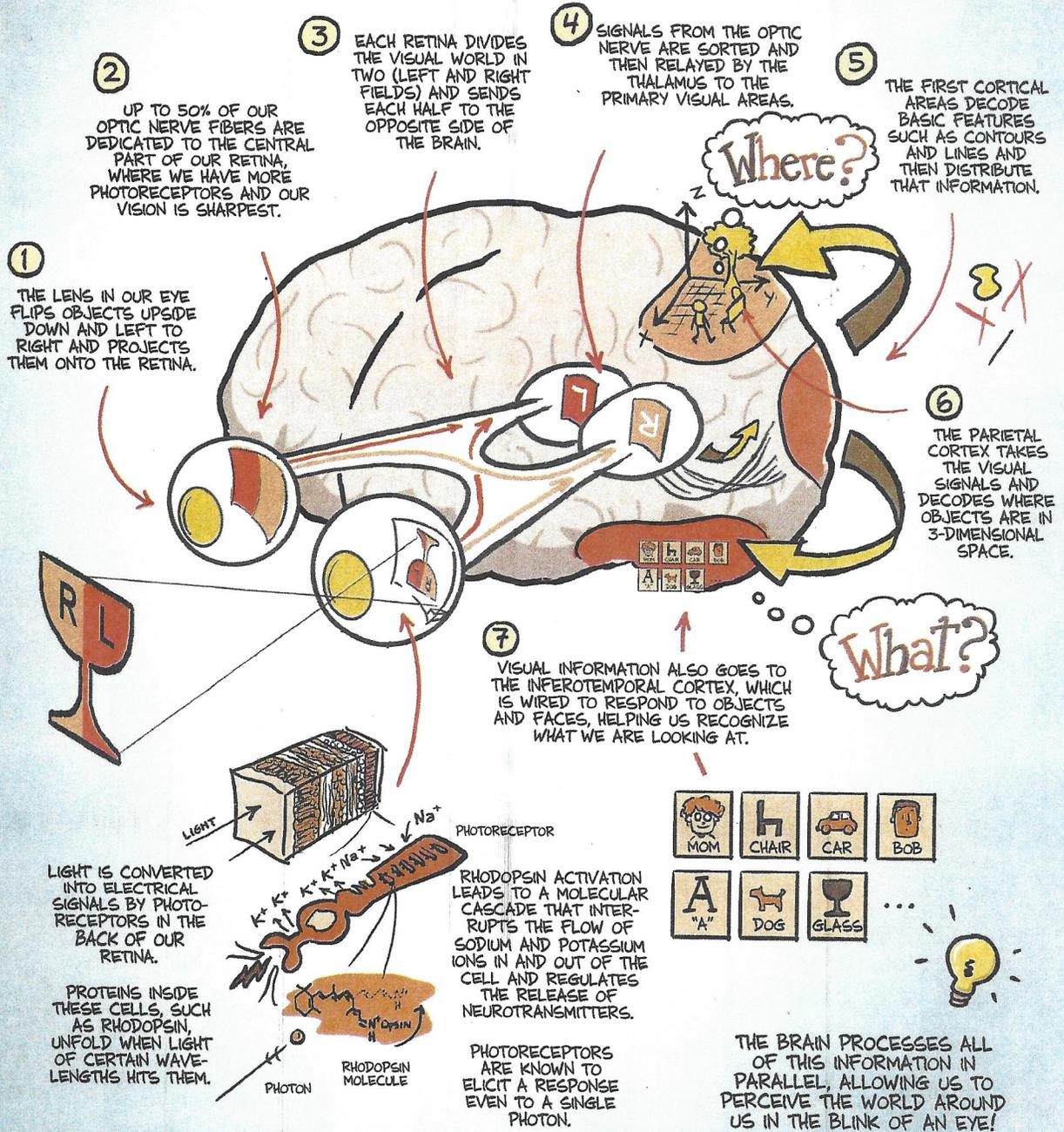
... IS FOR OUR KNOWLEDGE OF IT TO SPREAD EVEN FASTER.

● Dwayne Godwin is a neuroscientist at the Wake Forest University School of Medicine. Jorge Cham draws the comic strip *Piled Higher and Deeper* at www.phdcomics.com

BY DWAYNE GODWIN AND JORGE CHAM

WHAT YOU SEE IS WHAT YOU GET?

How the brain splits up what your eyes capture

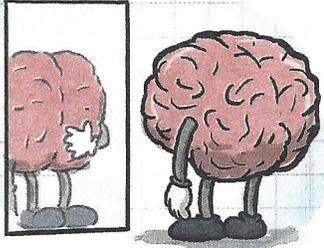


• **Dwayne Godwin** is a neuroscientist at the Wake Forest University School of Medicine. **Jorge Cham** draws the comic strip *Piled Higher and Deeper* at www.phdcomics.com

MIND IN MOTION

BY DWAYNE GODWIN
& JORGE CHAM

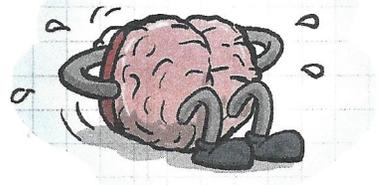
WANT TO GET YOUR
BRAIN IN SHAPE?



THERE IS ONE SURE WAY TO
IMPROVE YOUR MENTAL FITNESS:
MOVE!

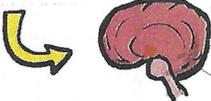


AEROBIC EXERCISE HAS BEEN
SHOWN TO REDUCE THE RISK OF
VASCULAR DEMENTIA, A CONDITION
CAUSED BY PROBLEMS IN YOUR
BRAIN'S BLOOD VESSELS.

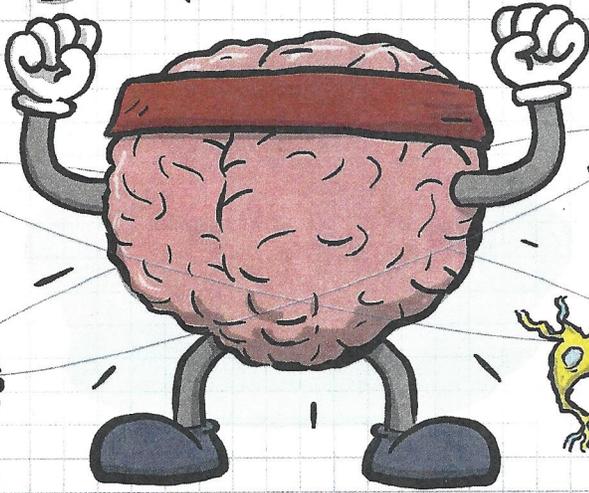


EXERCISE IS ALSO BENEFICIAL
AT THE MOLECULAR LEVEL:

EXERCISE STIMULATES
THE RELEASE OF GROWTH
HORMONE (GH) FROM
YOUR PITUITARY GLAND.



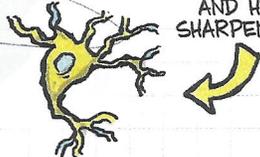
GH IN TURN STIMULATES
PRODUCTION OF THE
PROTEIN IGF-1, PRIMARILY
IN THE LIVER.



IGF-1, WHICH NORMALLY
TARGETS MUSCLE FOR
GROWTH, CROSSES INTO
YOUR BRAIN, WHERE IT
INCREASES PRODUCTION OF
BDNF, ANOTHER PROTEIN.



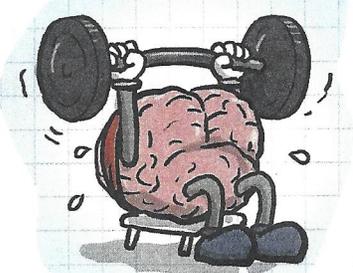
BDNF IS A NEUROTROPHIC
PROTEIN THAT SUPPORTS
NEURON DEVELOPMENT
AND HELPS TO
SHARPEN MEMORY.



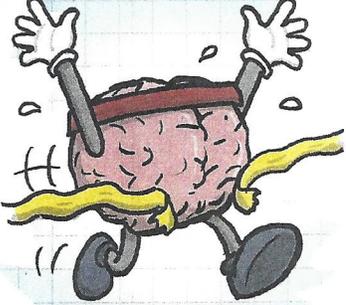
WHEN YOU WORK OUT, YOUR
ANTERIOR PITUITARY RELEASES
ENDORPHINS, THE BRAIN'S
NATURAL PAINKILLERS, WHICH IS
WHY MANY PEOPLE REPORT A
"HIGH" WHEN THEY EXERCISE.



DESPITE EVIDENCE THAT
EXERCISE IMPROVES MOOD
AND TEST SCORES, MANY
SCHOOLS ARE CUTTING PHYSICAL
EDUCATION PROGRAMS.



SO LET'S GET MOVING!



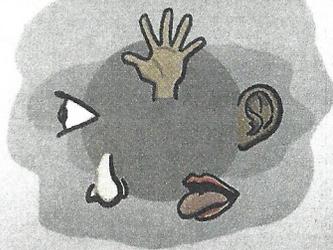
YOUR BODY (AND YOUR BRAIN)
WILL THANK YOU FOR IT.

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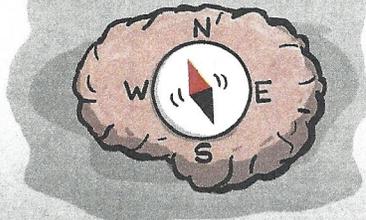
Mental Compass

BY DWAYNE GODWIN & JORGE CHAM

THERE ARE FIVE COMMON BASIC SENSES:



BUT DID YOU KNOW THAT SOME BRAINS CAN SENSE MAGNETIC FIELDS, LIKE A COMPASS?



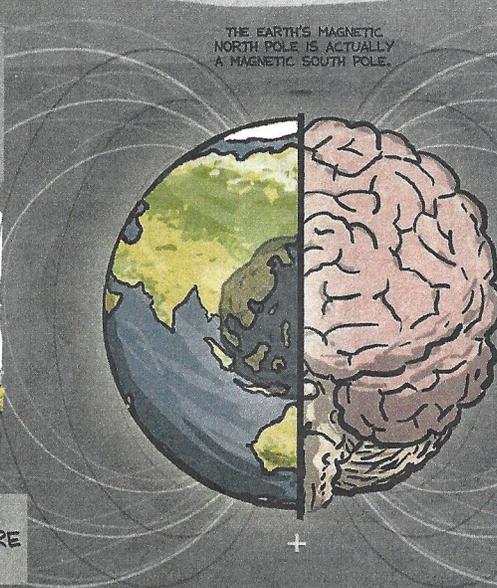
A VARIETY OF ANIMALS ARE ABLE TO NAVIGATE THE EARTH'S MAGNETIC FIELD TO AID THEM IN THEIR MIGRATION.



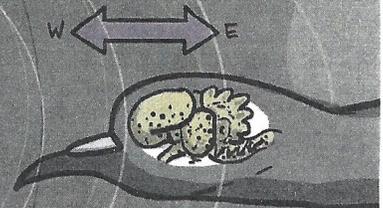
SOMEHOW THEIR BRAINS CAN DETECT THE SUBTLE MAGNETIC FIELD LINES CAUSED BY THE MOTION OF IRON IN THE EARTH'S MOLTEN OUTER CORE.



THE EARTH'S MAGNETIC NORTH POLE IS ACTUALLY A MAGNETIC SOUTH POLE.



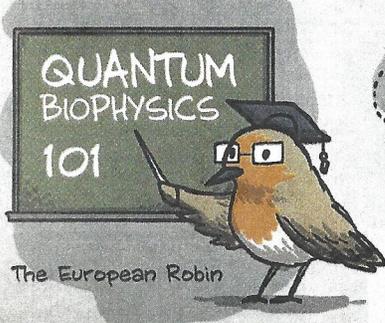
ONE HYPOTHESIS IS THAT THESE ANIMALS HAVE SPECIAL DEPOSITS OF LODESTONE, A MAGNETIZED OXIDE OF IRON, IN THEIR BODIES.



SCIENTISTS AREN'T SURE HOW THEY DO THIS, BUT THERE ARE SOME HYPOTHESES.

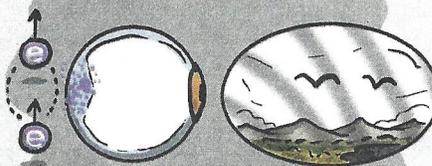
SPECIAL RECEPTORS IN THEIR NERVOUS SYSTEM THEN SENSE HOW THESE DEPOSITS REACT TO AN OUTSIDE MAGNETIC FIELD.

IN ONE ANIMAL, IT HAS BEEN HYPOTHESIZED THAT QUANTUM ENTANGLEMENT PLAYS A KEY ROLE.



The European Robin

A PROTEIN CALLED CRYPTOCHROME IN THE EYE'S PHOTORECEPTORS GENERATES TWO COUPLED ELECTRONS WHEN LIGHT STRIKES IT.



MAGNETOVISION

THE ENTANGLED ELECTRONS' SPIN IS AFFECTED BY WEAK MAGNETIC FIELDS, WHICH MAY ALLOW THE ROBIN TO "SEE" THE SURROUNDING MAGNETIC FIELD LINES.

SO YOU COULD SAY THESE ANIMALS HAVE A GOOD HEAD FOR DIRECTIONS ...



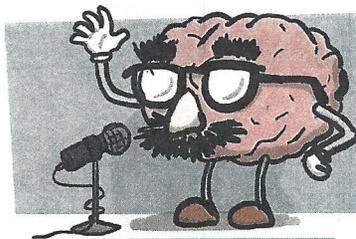
... OR THAT THEY'RE LOADED WITH ANIMAL MAGNETISM.

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The Brain's Funny Bone

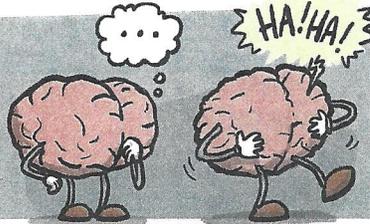
BY DWAYNE GODWIN & JORGE CHAM

WHAT HAPPENS IN YOUR BRAIN WHEN YOU FIND SOMETHING FUNNY?



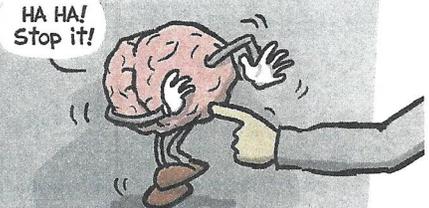
IT'S NO LAUGHING (GRAY) MATTER.

IN STUDIES, SCIENTISTS OFTEN SEPARATE OUR PERCEPTION OF HUMOR (CALLED "MIRTH") ...



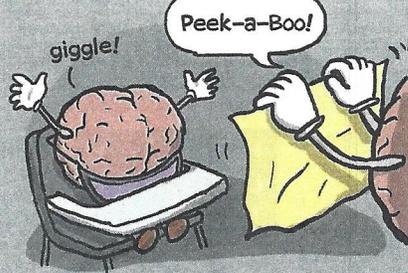
... FROM OUR RESPONSE TO HUMOR (CALLED "LAUGHTER").

THESE TWO THINGS ARE ASSOCIATED WITH DIFFERENT AREAS OF THE BRAIN:



TICKLING, FOR EXAMPLE, ELICITS LAUGHTER BUT NOT NECESSARILY MIRTH.

AREAS ASSOCIATED WITH THE PERCEPTION OF HUMOR ARE ALSO ASSOCIATED WITH THE PROCESSING OF INCONGRUITY, LIKE WHEN YOUR EXPECTATIONS ARE VIOLATED.



THIS RESPONSE HAS BEEN SHOWN TO CHANGE WITH AGE.



AREAS LIKE THE PREFRONTAL CORTEX, THE TEMPORAL LOBES AND THE SUPPLEMENTARY MOTOR AREA SEEM IMPORTANT FOR "GETTING" A JOKE ...

... WHILE DEEPER BRAIN AREAS, LIKE THE HYPOTHALAMUS AND PERIAQUEDUCTAL GRAY, APPEAR TO BE INVOLVED IN PRODUCING THE PHYSICAL REACTION OF LAUGHTER.

IT'S A PMRI: Pun-tional Magnetic Resonance Image.

STUDIES HAVE FOUND THAT WATCHING FUNNY CARTOONS ACTIVATES THE BRAIN'S REWARD CENTERS, RELEASING DOPAMINE.

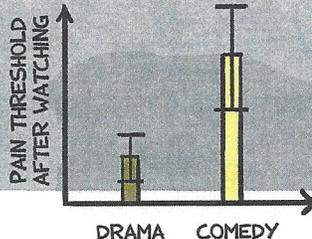
THE NEUROLOGICALLY FEEL-GOOD COMEDY OF THE YEAR!



That was dope!

WHICH IS WHY FEEL-GOOD COMEDIES, UM, FEEL GOOD.

LAUGHTER IS ALSO GOOD FOR YOU: IT'S BEEN SHOWN TO LOWER STRESS HORMONES AND MAY LEAD TO THE RELEASE OF ENDORPHINS, WHICH CAN INCREASE YOUR TOLERANCE TO PAIN.



SO HERE'S THE PUNCH LINE: DON'T JEST SIT THERE, YUK IT UP!



HUMOR AS MEDICINE IS NO JOKE.

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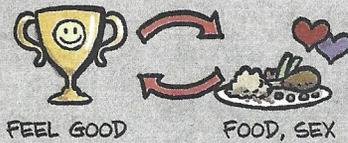
ADDICTION

BY DWAYNE GODWIN & JORGE CHAM

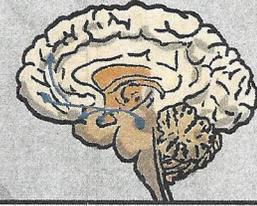
ADDICTION COSTS AMERICANS MORE THAN \$700 BILLION A YEAR IN LOST WORK, TREATMENT AND DRUG-RELATED CRIME.



ADDICTION HAS ITS ROOTS IN THE BRAIN'S REWARD SYSTEM.



ONE IMPORTANT COMPONENT IN THIS SYSTEM IS THE MESOLIMBIC PATHWAY ...



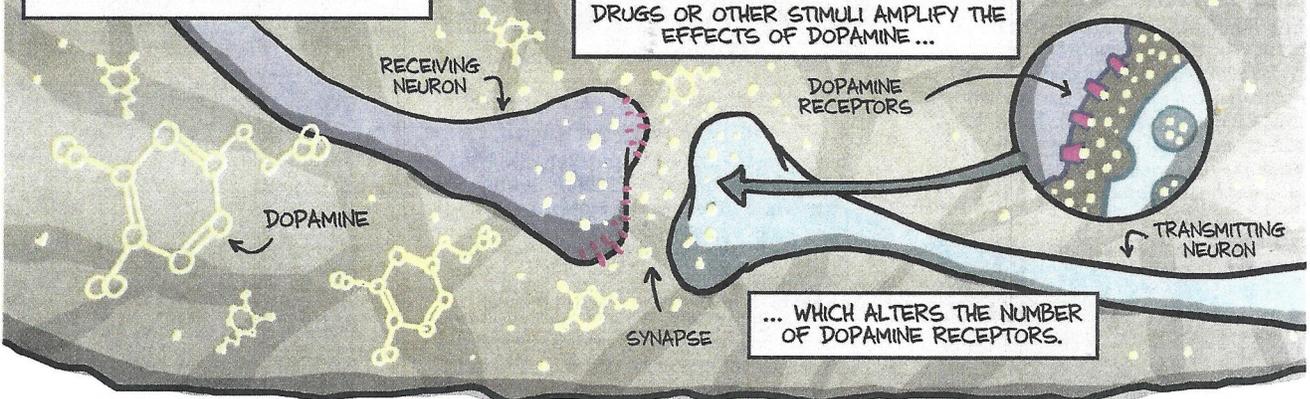
BUT WHAT IS ADDICTION ... AND HOW DO WE BREAK IT?

IT'S THE SYSTEM MEANT TO REINFORCE BEHAVIORS NEEDED FOR SURVIVAL, SUCH AS EATING AND HAVING SEX.

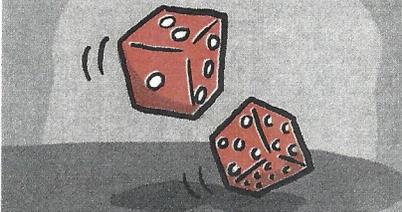
... A COLLECTION OF NEURONS THAT PRODUCES AND RELEASES DOPAMINE WHENEVER YOU ENGAGE IN REWARDING BEHAVIORS.

DOPAMINE IS A NEUROTRANSMITTER THAT, AMONG MANY OTHER THINGS, GIVES YOU THE SENSATION OF PLEASURE WHEN RELEASED IN CERTAIN BRAIN AREAS.

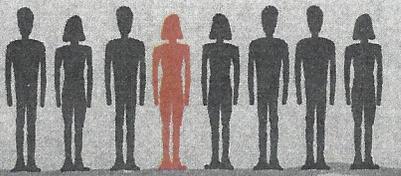
ADDICTION CAN OCCUR WHEN THIS PATHWAY IS HIJACKED REPEATEDLY BY DRUGS OR OTHER STIMULI, CREATING CHANGES IN THE SYNAPTIC CONNECTION THAT ARE HARD TO REVERSE.



THIS CHANGED PATHWAY, ALONG WITH INCREASED STRESS, DURING WITHDRAWAL, DRIVES ADDICTS TO COMPULSIVELY SEEK OUT THE STIMULUS ...



NOT ALL DRUGS OR ADDICTS ARE THE SAME. SOME PEOPLE ARE GENETICALLY MORE SUSCEPTIBLE TO ADDICTION ...



HEALING ADDICTION IS A DIFFICULT PROCESS, AIDED BY GROUP SUPPORT.



... DESPITE LONG-TERM NEGATIVE CONSEQUENCES.

... AND A DRUG'S ADDICTIVENESS SEEMS TO DEPEND ON HOW RAPIDLY IT ACTS ON YOUR SYSTEM.

THE BEST WAY TO BEAT A HARMFUL DEPENDENCY IS BY DEPENDING ON OTHERS.

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