



GRAPHIC MEDICINE REVIEW

New Leaves on the Tree: How Trauma Affects Inheritable Gene Expression

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ABSTRACT

This comic explores research conducted on the effects of intergenerational trauma on inheritable gene expression, and the symptoms of inherited trauma that a person might exhibit 1-3 generations after a traumatic event, including anxiety, depression, and other PTSD symptoms. In this comic, I address and differentiate Complex PTSD from PTSD to aid readers with diverse trauma histories in seeing the relevance of the data presented to themselves and their experiences. I use concepts and research from Mark Wolynn's *It Didn't Start With You* as a central framework for this comic, and briefly summarize excerpts of relevant findings from epigenetic research studies conducted in the last 20 years as well as historical events providing evidence of PTSD symptoms in generations succeeding cultural and historical traumatic events. The research presented illustrates the presence of altered gene expression as a result of environmental and emotional stressors. The conclusion emphasizes the reversibility of epigenetic gene expression and encourages readers to create new neural pathways with a focus on love, healing, and well-being.

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CONTEXT

According to the World Health Organization, anxiety disorders are the most common of all mental disorders, affecting 4% of the global population, or 301 million people in 2019 (Sept. 2023). Depression disorders are also extremely common, affecting 3.8% of the global population, or 280 million people (World Health Organization, Mar. 2023). Anxiety and depression are commonly experienced together, and though both result from “a complex interaction of social, psychological, and biological factors,” and anyone can have these disorders, people who have lived through abuse, traumatic events, and other adverse life events are more likely to develop them (Sept. 2023).

Trauma can stem from war and violence, grief and loss, abuse or neglect including physical, emotional, and sexual abuse, natural disasters, medical intervention, and cultural and historical trauma. According to the National Council for Community Behavioral Healthcare, 70% of U.S. adults have experienced a traumatic event at least once, and 20% who experience a traumatic event will develop Post Traumatic Stress Disorder (PTSD) (Zauderer, 2023). In 2023, most people know what PTSD is and are familiar with its symptoms, such as anxiety, depression, flashbacks, and recurring intrusive memories or nightmares, trouble sleeping, being easily startled, an exaggerated fight-or-flight response, shame, irritability, and detachment. People who experience a major or violent traumatic event will likely be able to trace their PTSD symptoms to the event. However, others may experience similar symptoms without having experienced such an event. This comic seeks to offer a possible explanation to people who suffer PTSD symptoms whether or not they feel they deserve to, to validate their experiences, and to possibly offer the resolution that follows understanding.

Firstly, though most people have heard of PTSD, many may not be familiar with its lesser-known counterpart, Complex PTSD (cPTSD). While PTSD occurs after a single traumatic event triggers a fight-or-flight response so intense that the person can no longer turn it off, cPTSD develops from chronic trauma, even at less intense levels. Complex PTSD can result from extended periods of verbal, mental, emotional or psychological abuse, extended periods of physical or sexual abuse, or even just emotional neglect (Walker, 2013). While some of these, such as physical abuse, will be easier to identify as abuse, others such as emotional neglect may feel “normal” to the victim who experienced it as a child, and these people will often fail to recognize their cPTSD symptoms for what they are. cPTSD symptoms include depression, anxiety, suicidality, radical mood vacillations, social anxiety, inhibition to seek help or connection, attachment disorders, an exaggerated fight-or-flight response, being easily startled, oversensitivity to stressful situations, developmental arrests, and emotional flashbacks.

People who experience the symptoms of PTSD and cPTSD are the intended audience of this comic, and the author offers it with empathy as an exploration of the potential origins of these symptoms. Although many readers with cPTSD may trace the origin of this disorder to their childhoods and the way they were treated by their parents, I encourage readers to understand their parents as survivors of experienced and/or inherited trauma also. What people teach their children about how to value themselves, how to build relationships, where to expect danger, how to interact with the world, and so on, is based on what they’ve learned and on their ability to parent, both of which can often be affected by their own mental health. Furthermore, research studies in epigenetics reveal trauma and stress affect inheritable gene expression, which means that trauma suffered by one generation can affect the succeeding generations on even a biological level. This is the premise of research psychologist Mark Wolynn’s 2017 book *It Didn’t Start with You: How Inherited Family Trauma Shapes Who We Are and*

How to End the Cycle, which I use as a central framework for this comic. Your trauma didn't start with you, and it most likely did not start with your parents either.

Epigenetics is the study of heritable gene function that occurs without a change in the sequence of DNA. Chromosomal DNA, responsible for physical traits like hair color and eye color makes up just 2% of our DNA, whereas non-Coding DNA (ncDNA), responsible for emotional behavioral, and personality traits, make up 98%. ncDNA is known to be affected by environmental stressors like toxins, inadequate nutrition, and big emotions like stress, shame, and fear (Wolynn, 2017, p. 29). These stressors will trigger epigenetic tags, or chemical signals that attach to DNA to either silence or activate a gene, altering its expression. These tags will be passed along with the DNA, and they will affect the DNA of the fetus in a pregnant mother, as well as the precursor sperm or egg cells in that fetus. This applies also to the egg cells present in the body of a female who is not pregnant, all of which are present in her body from 5 months of her inception. Similarly, the precursor sperm cells that will become the next generation are present in a man's body when he is affected by environmental stressors, and epigenetic changes in his DNA occur in these cells as well (Wolynn, 2017, pp. 25-26). In the sense that we shared a biological environment with our parents when we were sperm, egg, and precursor cells in their bodies, and with our grandmothers when they were pregnant with our mothers, we were "present" for and directly affected by the trauma they experienced, and the epigenetic tags in our DNA can be passed to our children also, who were not.

Rachel Yehuda, a leading expert in PTSD and epigenetics, conducted with her research team a number of studies that found that children with mothers with PTSD had genes that expressed differently from those whose mothers had not (Wolynn, 2017, p. 31). According to Yehuda, the function of these epigenetic tags is to biologically prepare us to cope with what our parents went through by giving us the traits we would need for that environment. This "environmental resilience" is on the one hand helpful in aiding us to maneuver stressful situations, but on the other hand destructive if there is a mismatch between biological readiness and actual environment (Wolynn, 2017, p. 30). For example, an epigenetic tag causing a heightened or more sensitive startle response is helpful in emergency situations, but in day-to-day life it could result in chronic stress, which can lead to weight gain, fatigue, acne, irritability, headaches, difficulty concentrating, and more. Increased amounts of epigenetic tags activating genes that trigger cells to release stress hormones have been found in people with depression and anxiety. Not only do these things negatively impact current well-being, they may also predispose someone to stress disorders and disease later in life.

CONCLUSION

Stress and mood disorders negatively impact health and well-being, and these disorders may be due in part to inherited gene expression; the positive counterpart to this information is that positive emotions like hope, love, and serenity are as powerful as negative emotions like stress, fear and shame. It is possible and beneficial to seek to resolve fears that originated in our pasts so that we may stop living with them as though they belong in the present. Letting go of negative emotions that we either harbor for our parents or that were passed down to us by our parents, and instead intentionally focusing our attention repeatedly on thoughts of love and well-being can create new neural pathways, deactivate or silence epigenetic tags inherited from trauma suffered by our parents and ancestors, and reverse the effects of trauma on our gene expression.

DESIGN PROCESS

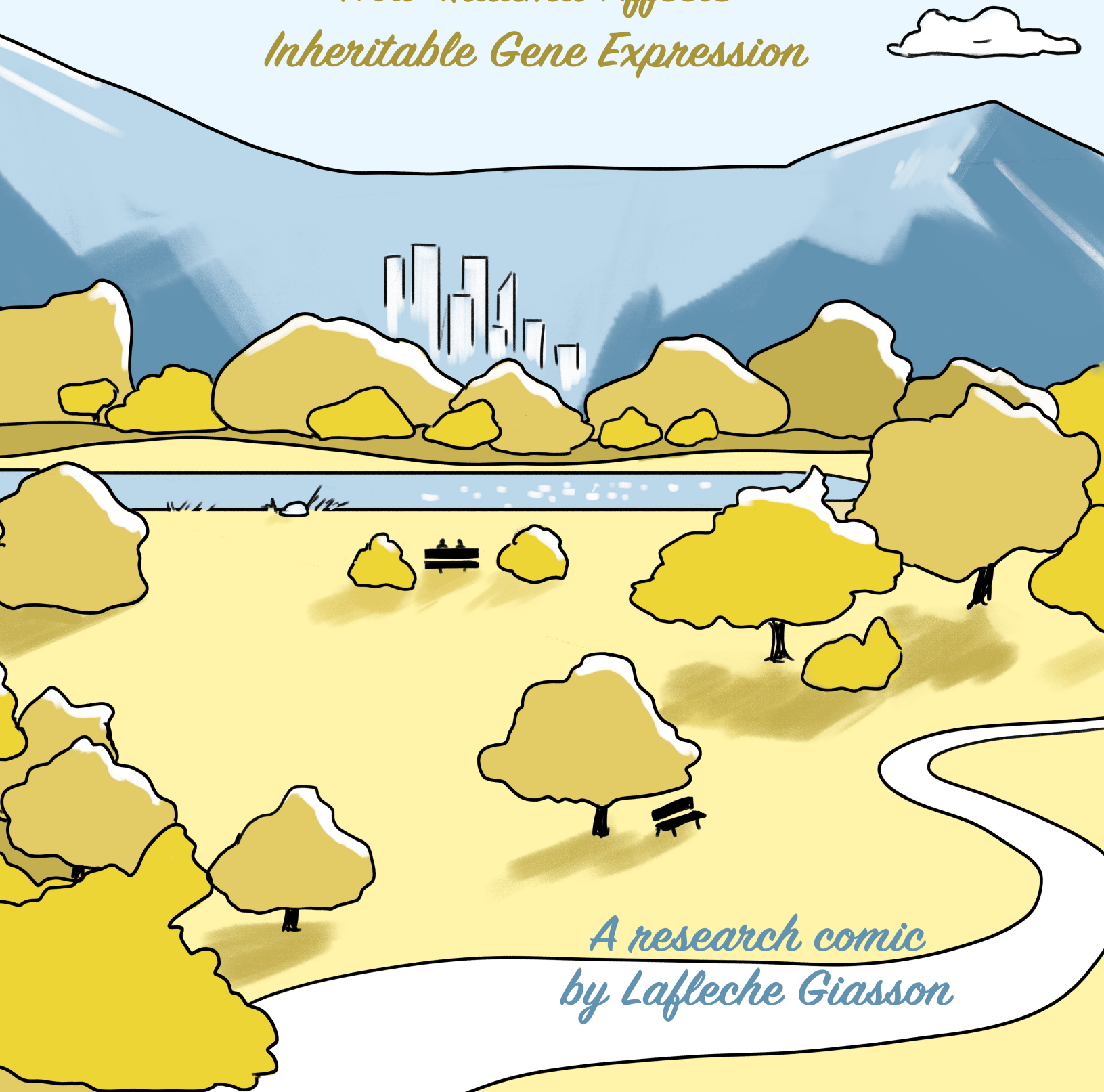
I delivered the research content of this comic within the context of an empathetic conversation between friends sitting in a city park and used the park environment to facilitate visual metaphors during their conversation; for example, providing an image of a family of geese when talking about parents, or of bird eggs in a nest when directing the narrative to a time before we are born. To draw this 16-page comic meant to efficiently cover a lot of information as effectively as possible, I used a visually clear drawing style with clean black ink lines and selective black color blocking, and colored it with a limited palette of muted blue and yellow tones. I chose these colors because I find the semi-complementary pairing of blue and yellow pleasing and muted them to keep the visual experience calm to match the tone of the conversation and to avoid overwhelming the reader, particularly when the content is complex and sensitive.

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New Leaves On The Tree

*How Trauma Affects
Inheritable Gene Expression*



*A research comic
by Lafleche Giasson*

New Leaves On The Tree

*How Trauma Affects
Inheritable Gene Expression*



*A research comic
by Lafleche Giasson*



*according to the National Council

Trauma can stem from:

war and violence

grief and loss

childhood abuse or neglect

natural disasters

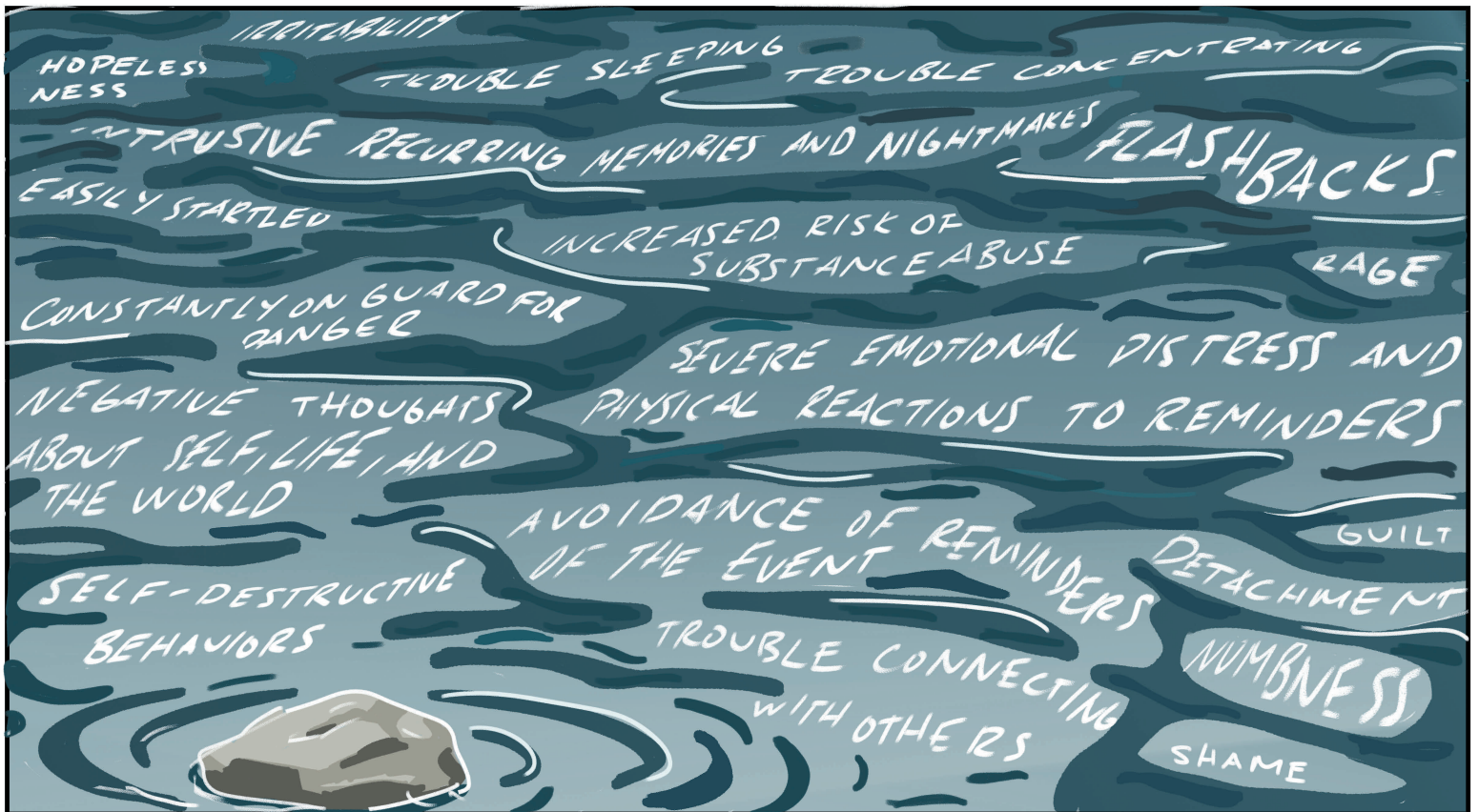
physical, emotional, or sexual abuse

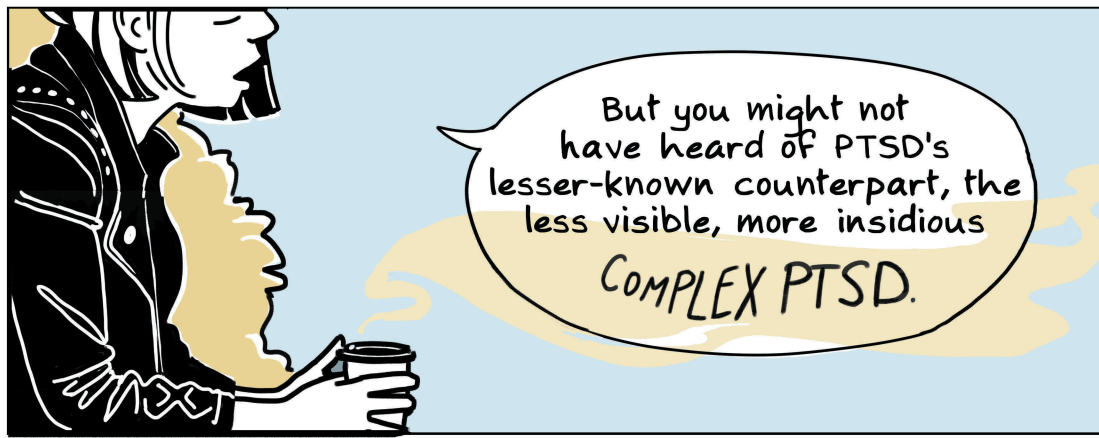
medical intervention

cultural and historical trauma

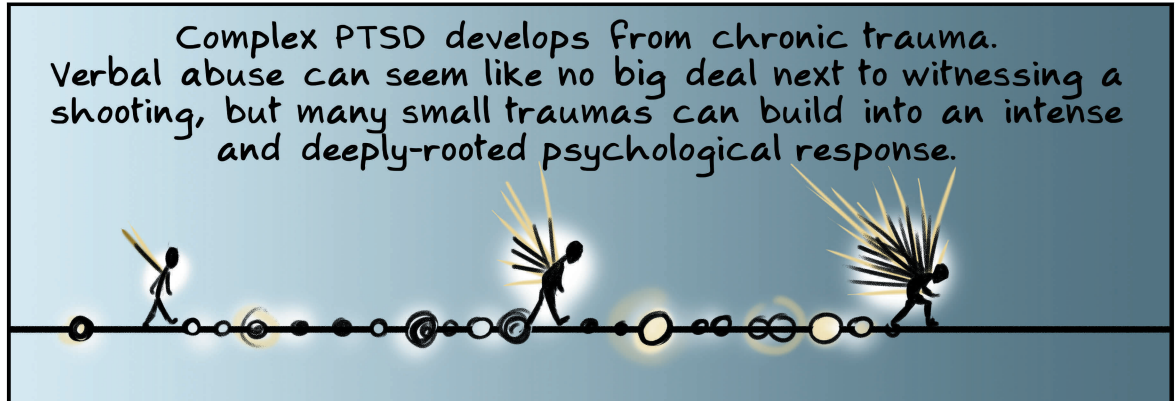


In 2023, most people know what PTSD is and are familiar with the symptoms.

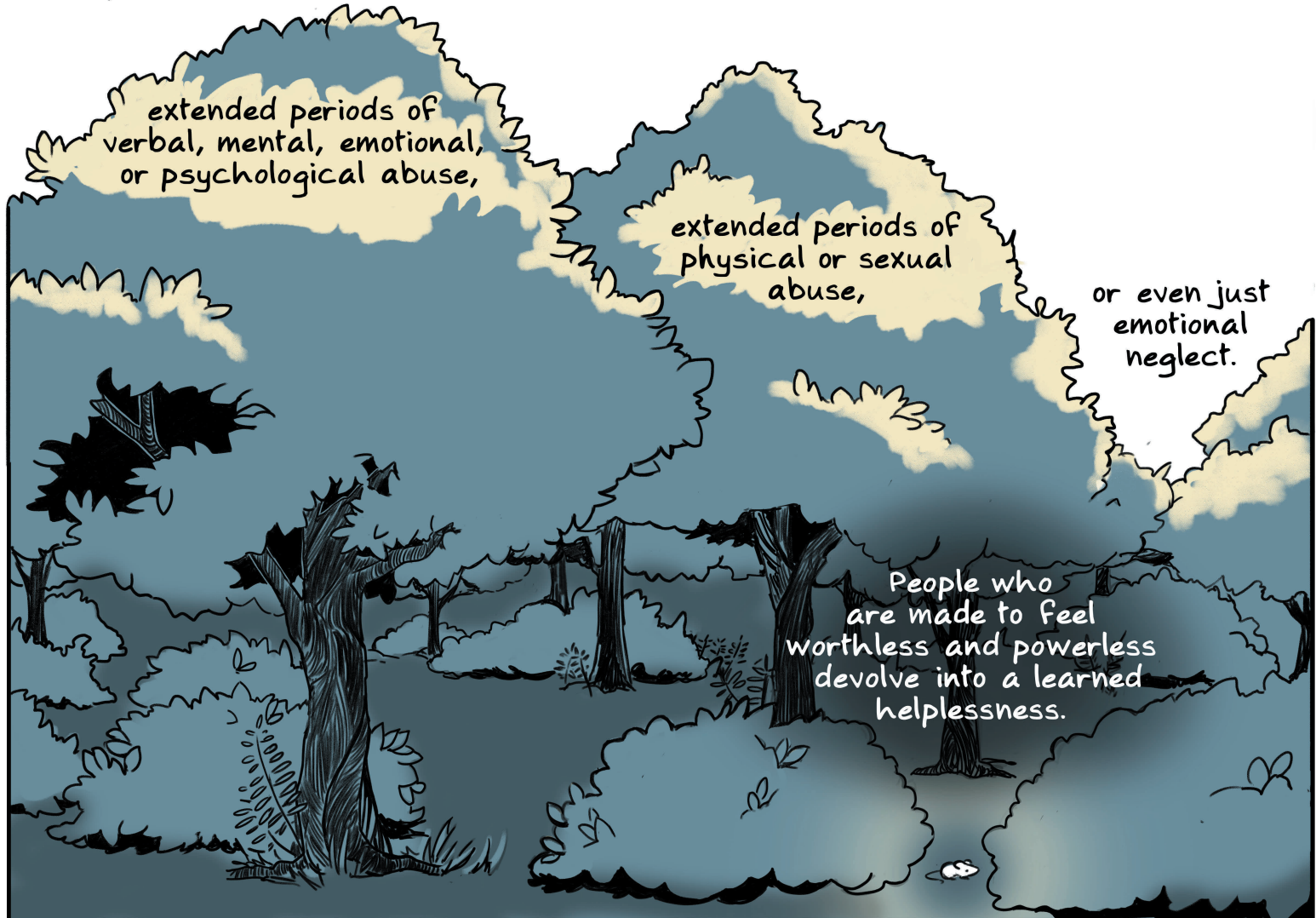




Trauma occurs when attack or abandonment triggers a fight/flight response so intense the person can no longer turn it off.



Complex PTSD can result from:



Without seeming or feeling like anything
"that bad" has happened to them, people
with Complex PTSD can experience:

ABJECT FEELINGS
OF LONELINESS OR
ABANDONMENT
DEPRESSION
ANXIETY
SUICIDALITY
RADICAL MOOD
VACILATIONS

FRAGILE SELF-ESTEEM
SELF-ABANDONMENT
TYRANNICAL
INNER CRITIC
**TOXIC
SHAME**

EASILY STARTLED
HAIR TRIGGERED
FIGHT/FLIGHT
RESPONSE
OVERSENSITIVITY
TO STRESSFUL
SITUATIONS

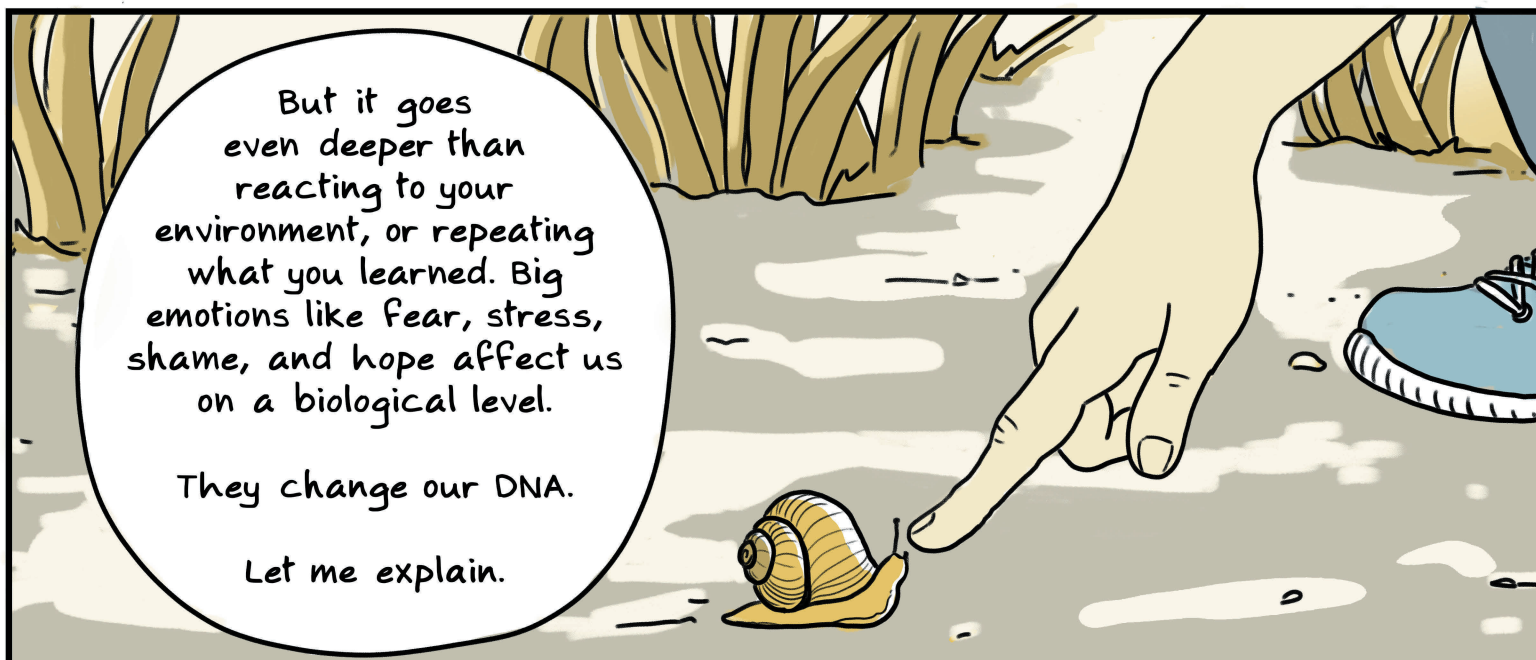
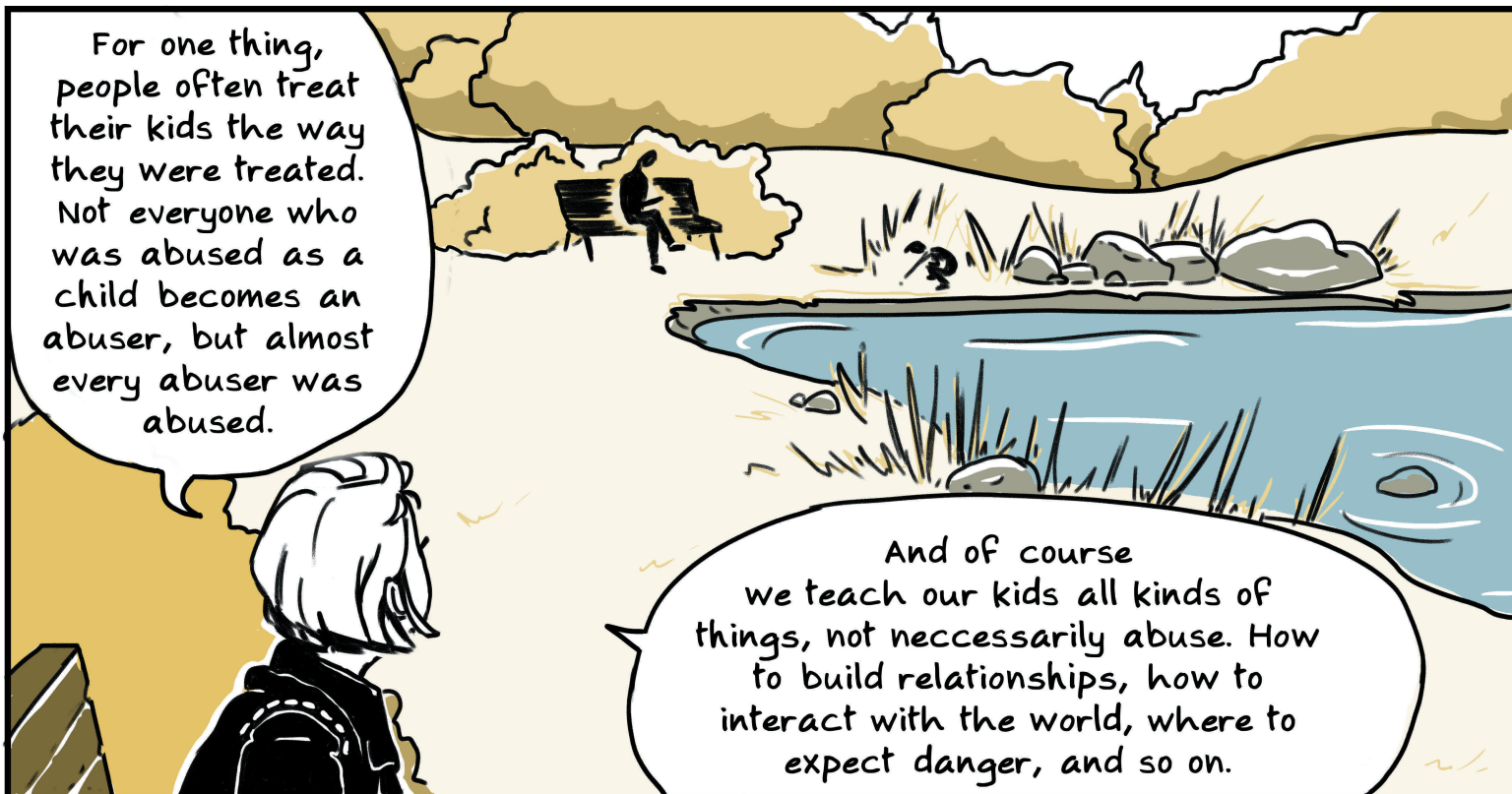
SOCIAL ANXIETY
INHIBITION TO SEEK
HELP OR CONNECTION
RELATIONSHIP DIFFICULTIES
**ATTACHMENT
DISORDERS**

**EMOTIONAL
FLASHBACKS**

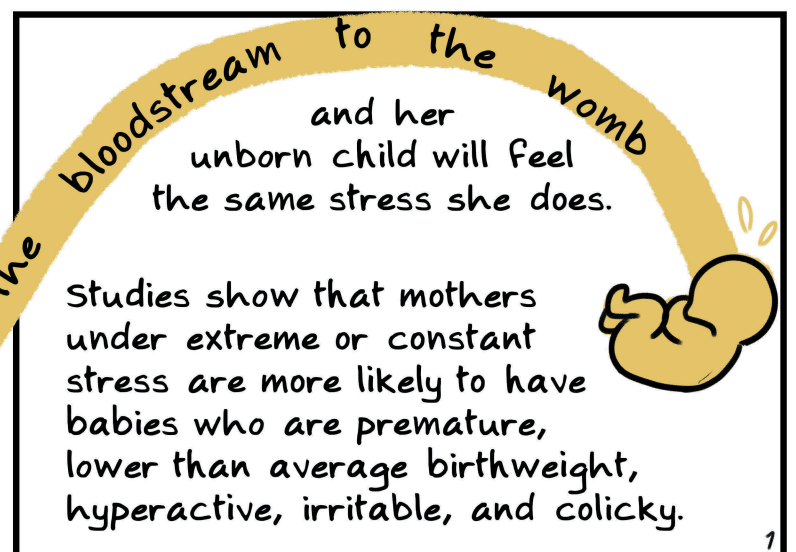
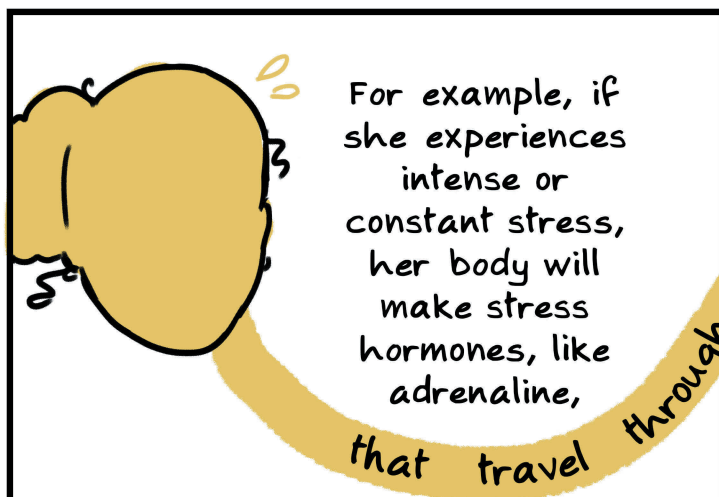
**DEVELOP-
MENTAL
ARRESTS**

Learning this, it's
tempting to blame
our parents for
our problems.





We'll use research psychologist Mark Wolynn's 2016 book It Didn't Start With You to explore research done on intergenerational trauma in the preceding 20 years.



So we're directly affected by what happens to our mothers while we're in the womb,



and studies in epigenetics show us how our DNA can be affected by stuff that happened even before that.

Here's how it works.

EPIGENETICS (n): The study of heritable gene function that occur without a change in the sequence of DNA.

Chromosomal DNA, responsible for physical traits like eye color, hair color, etc., makes up just 2% of our total DNA.

The other 98% consists of non-Coding DNA (ncDNA), which is responsible for the emotional, behavioral, and personality traits we inherit.

ncDNA is known to be affected by environmental stressors like:

TOXINS

INADEQUATE NUTRITION

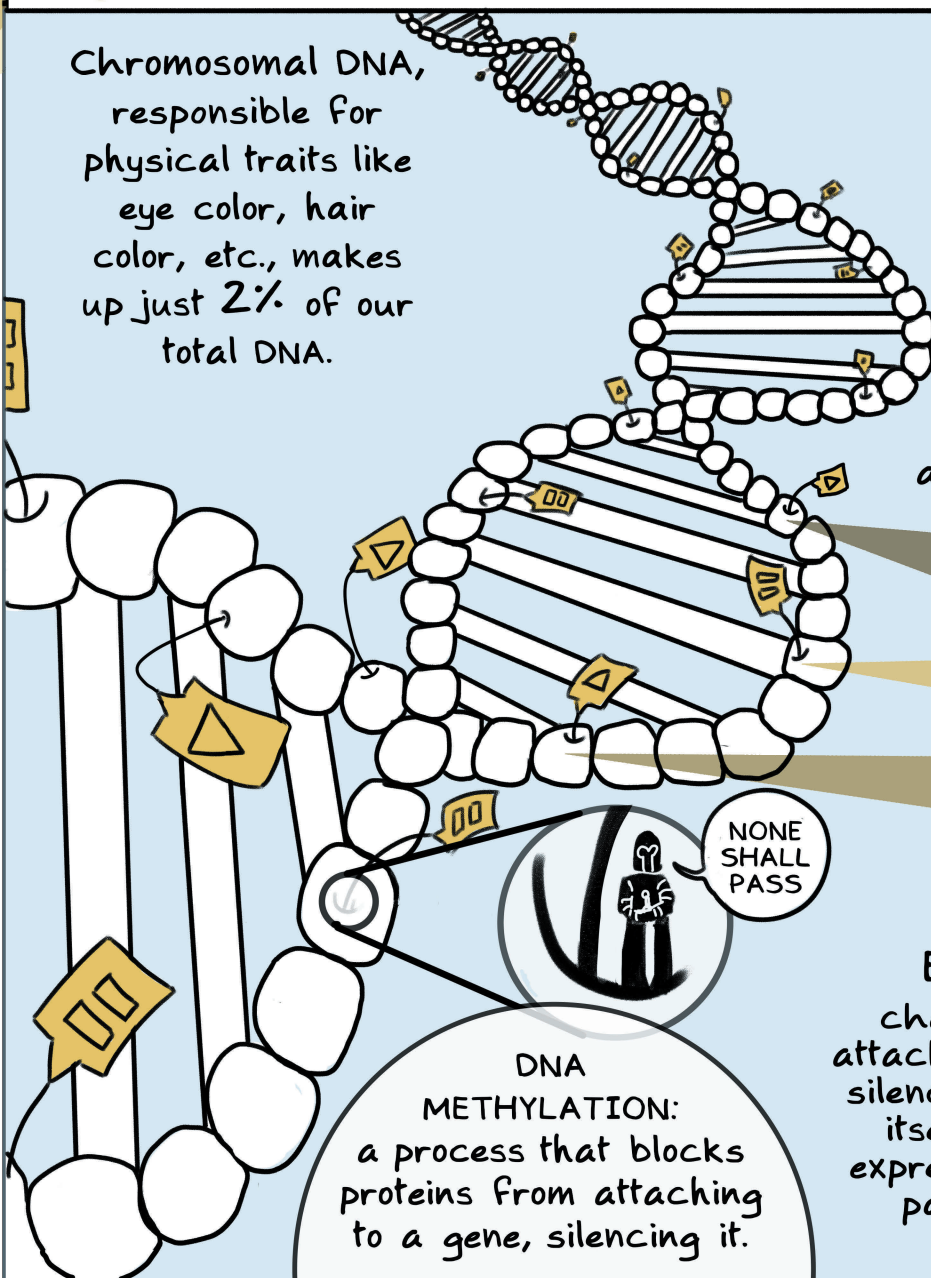
STRESSFUL EMOTIONS

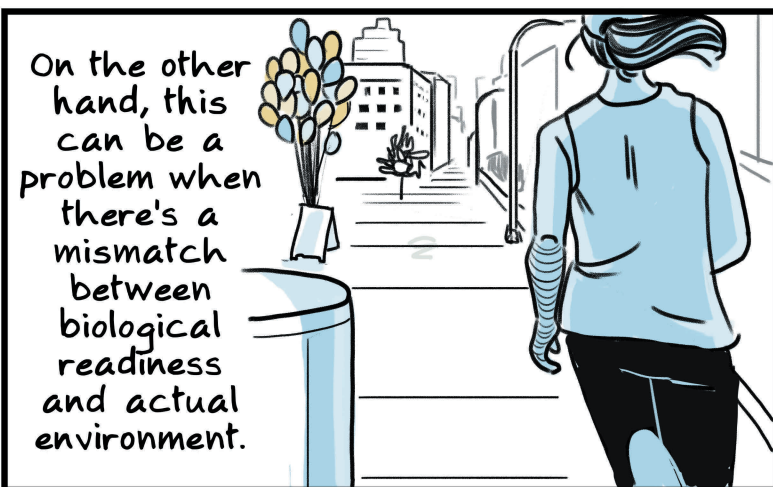
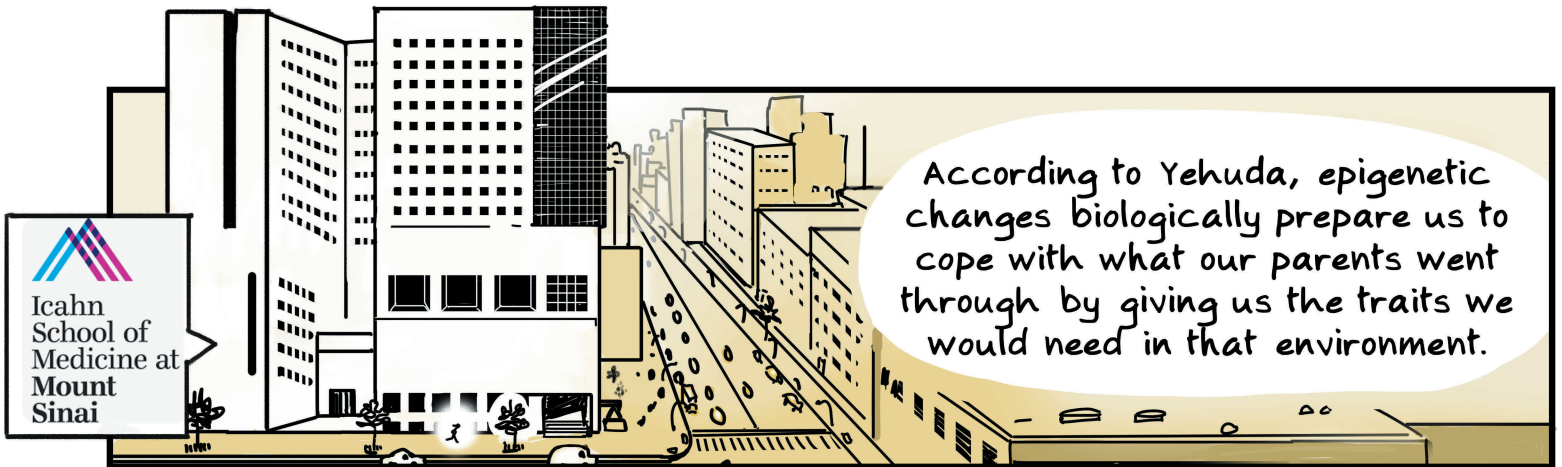
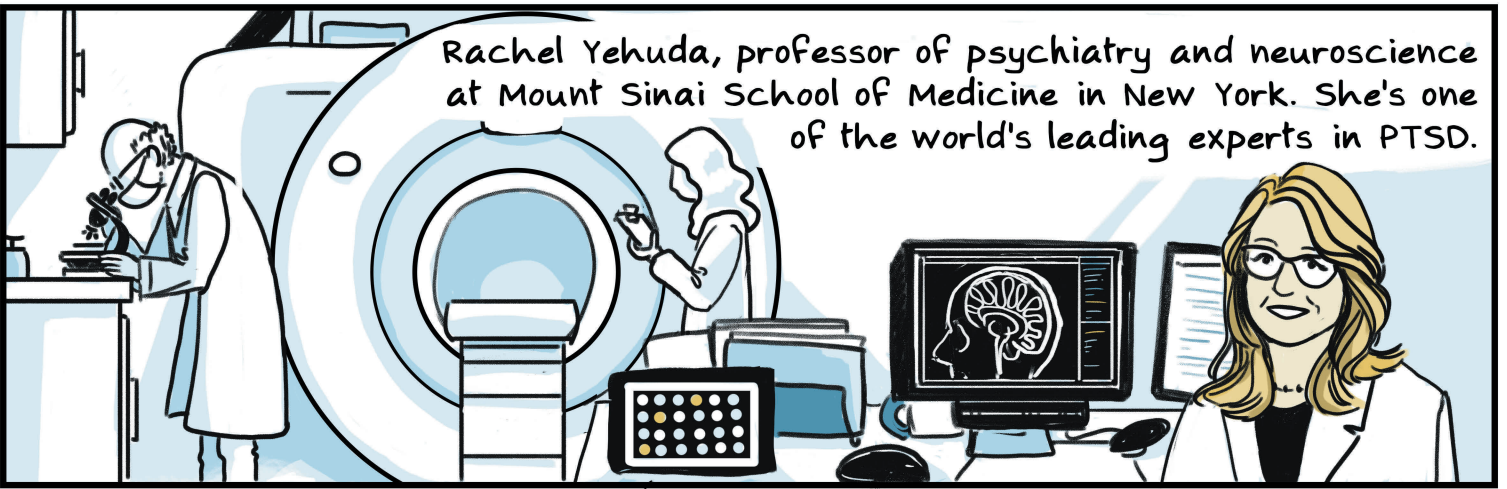
Stressors will trigger **EPIGENETIC TAGS:**

chemical signals in cells that attach to DNA to either activate or silence a specific gene. The DNA itself doesn't change, but its expression does. The tags will be passed along with the DNA.

DNA METHYLATION:
a process that blocks proteins from attaching to a gene, silencing it.

NONE SHALL PASS





For example, the child of a parent who lived in a war zone might inherit the impulse to jump and recoil from sudden noises.

In response to stress, the body releases short bursts of stress hormones like cortisol.

Cortisol regulates the body's stress response.

It also regulates: metabolism, inflammation, blood pressure, blood sugar, and the sleep/wake cycle.



Chronic stress can lead to high cortisol levels, which can cause weight gain, fatigue, acne, thin skin and easy bruising, irritability, headaches, difficulty concentrating, and more.

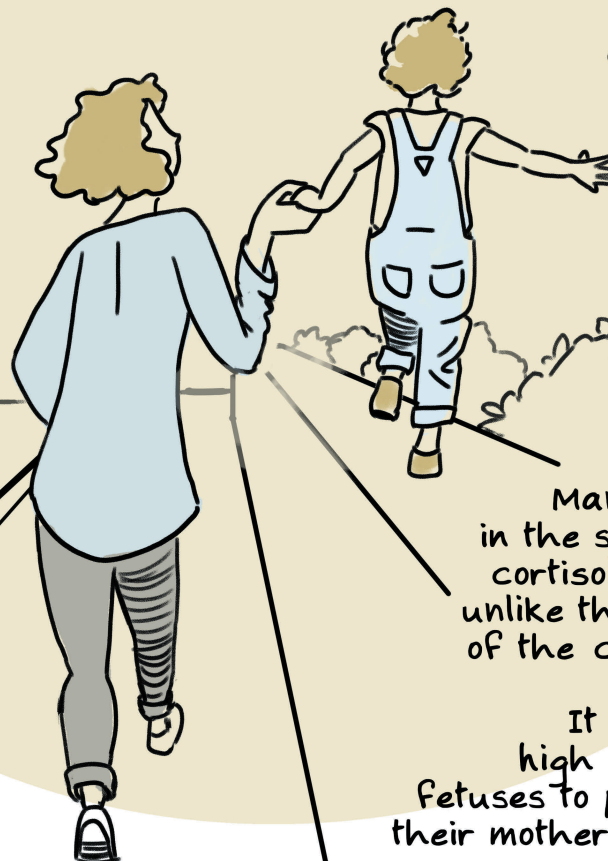
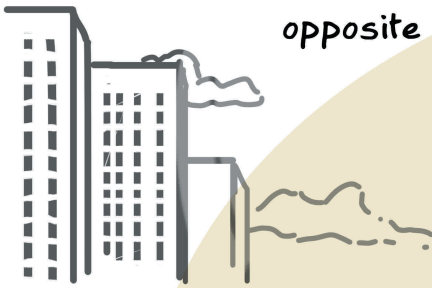
So although a high startle response might be helpful in emergency situations, in day-to-day life it could predispose someone to stress disorders and disease later in life.

It's not clear why, but the Yehuda studies found that survivors of 9/11 and of the holocaust had low levels of cortisol, which is the opposite of what we would expect.... They also found low levels of an enzyme that breaks down cortisol, though.

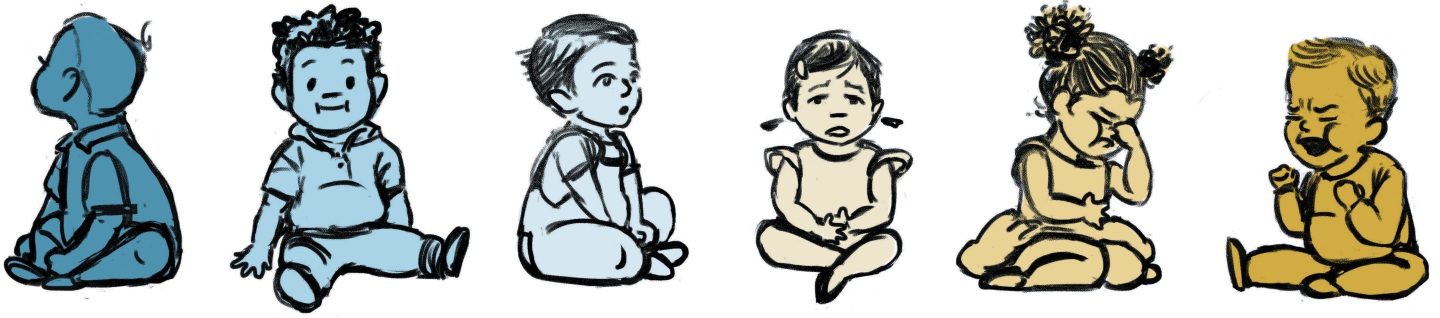
So it seems the survivor's body reduced enzyme activity to keep more free cortisol in the body, which the body needs to manage prolonged starvation and other stress.

Many children of survivors in the studies had low levels of cortisol like their mothers, but unlike their mothers, high levels of the cortisol-busting enzyme.

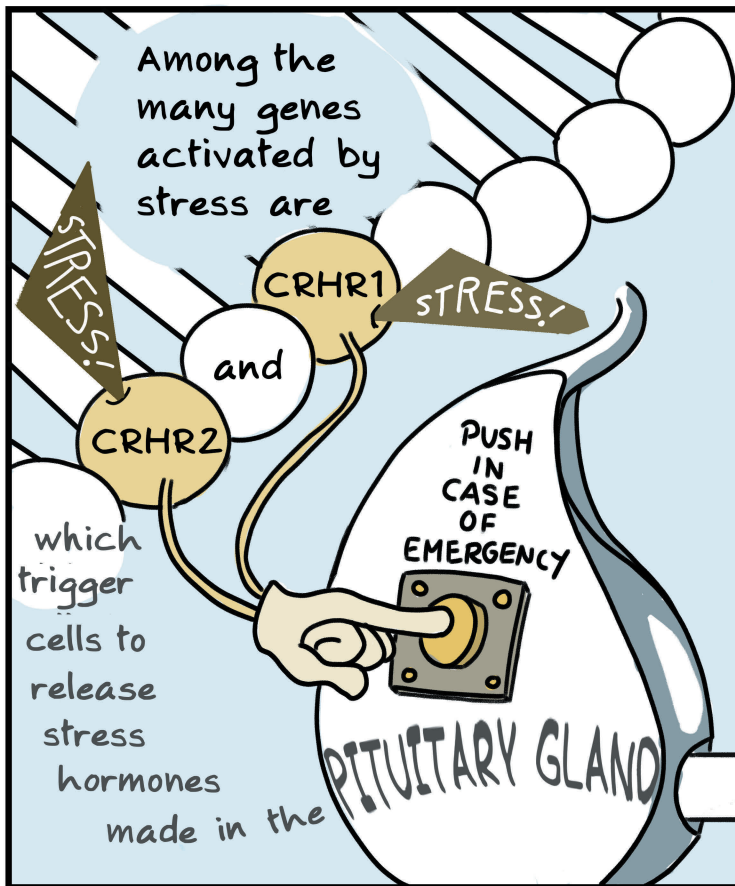
It appears they developed high levels of the enzyme as fetuses to protect themselves from their mother's free cortisol in utero.



Besides low cortisol levels, Yehuda and her team also found sixteen genes that expressed differently in the children of mothers who developed PTSD after 9/11 compared to those whose mothers had not.



These children were more easily disrupted by loud noises and unfamiliar people.

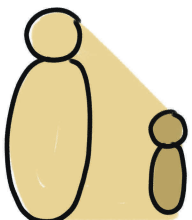


Epigenetic stress hormones: Corticotropin hormones like CRH and ATCH

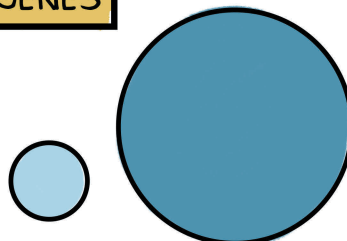


Increased amounts of CRHR genes have been found in people with depression and anxiety.

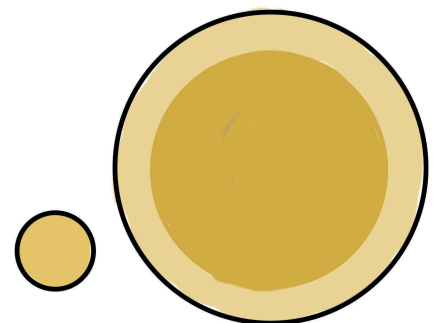
WHEN THE STRESS IS IN YOUR GENES



Children with parents struggling with PTSD will sometimes develop their own, called **Secondary PTSD**.



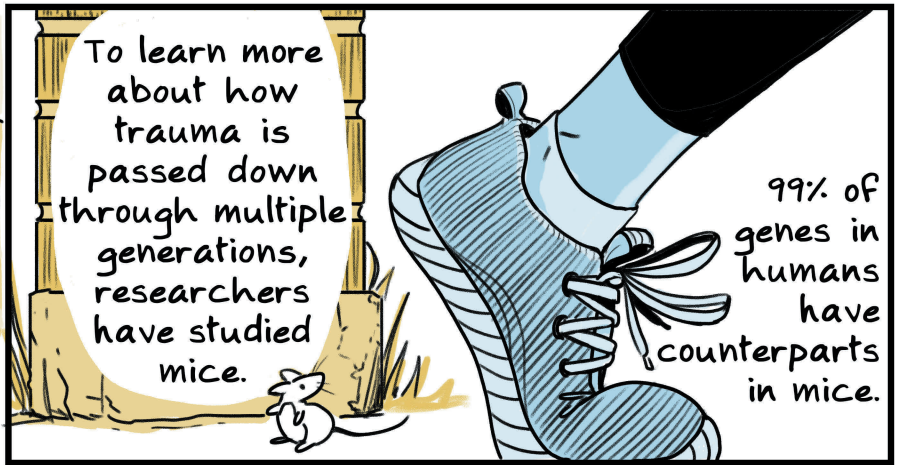
Children of PTSD-stricken parents are **3 times** more likely to be **diagnosed with PTSD**.



Children of survivors are **3-4 times** more likely to struggle with **depression, anxiety, and/or substance abuse**.



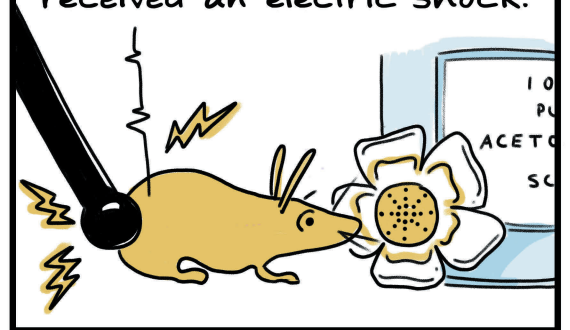
The study of epigenetics is pretty new, with most studies conducted after 2000.



In a 2013 study involving the offspring of stressed male mice, mice in one generation were trained to fear a cherry blossom-like scent.



Each time they were exposed to the smell, they received an electric shock.



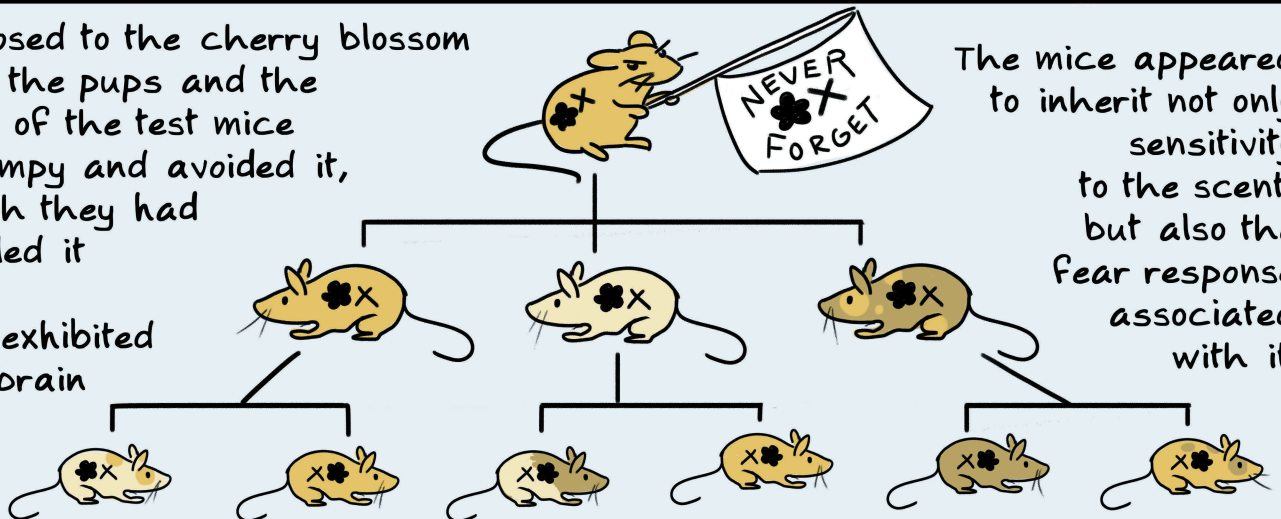
After a while, the shocked mice had a greater amount of smell receptors associated with the scent, allowing them to detect it at lower concentrations, as well as larger brain areas devoted to those receptors.



Researchers were also able to identify changes in the mice's sperm.

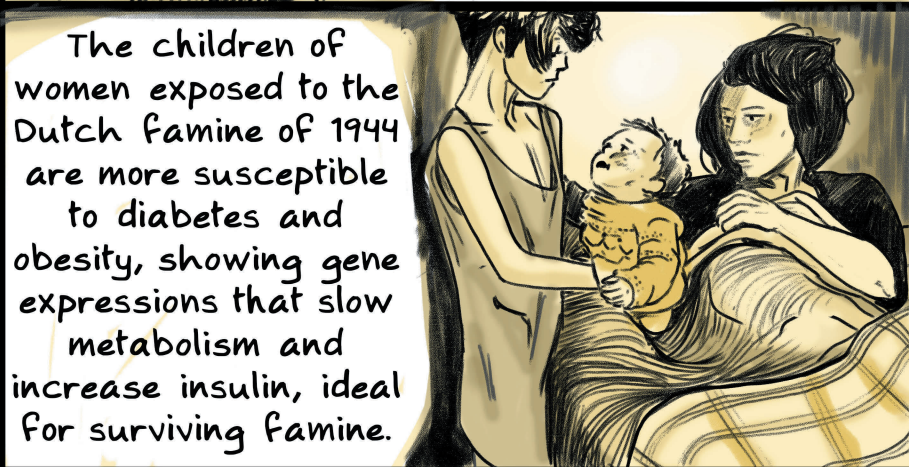
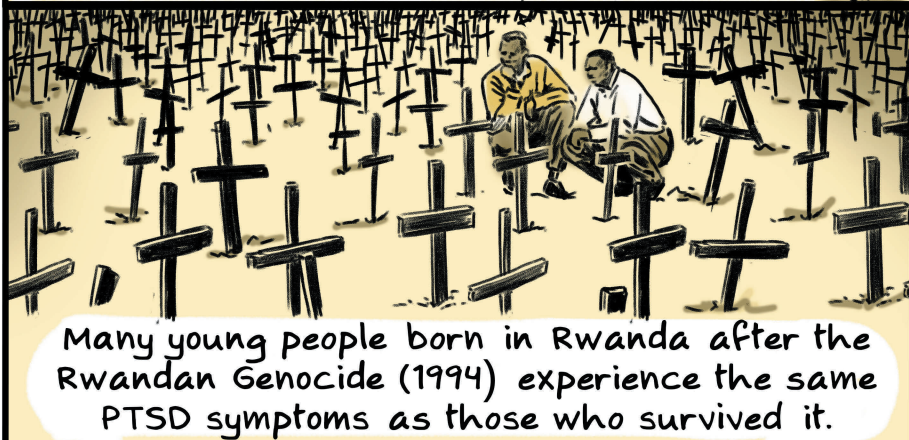
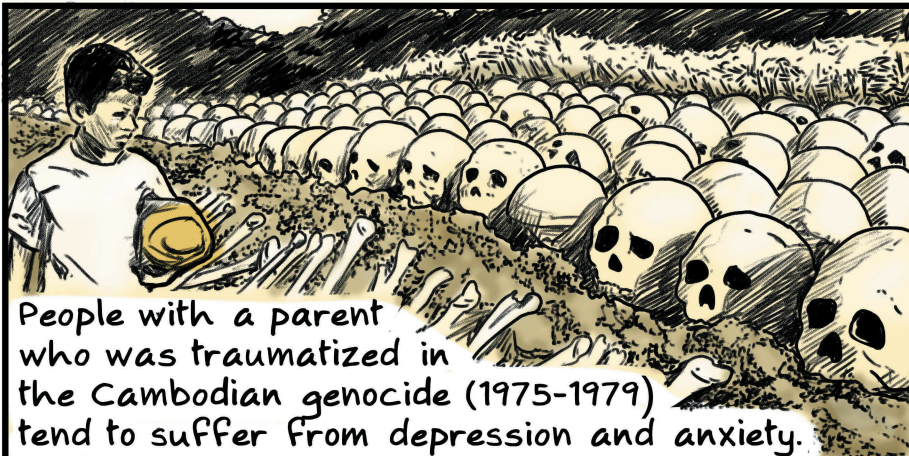


When exposed to the cherry blossom odor, both the pups and the grandpups of the test mice became jumpy and avoided it, even though they had never smelled it before. They also exhibited the same brain changes.



The mice appeared to inherit not only sensitivity to the scent, but also the fear response associated with it.

It's harder to gather similar data on 3 generations of humans - that takes up to 60 years! Still, there's a ton of historical evidence of intergenerational and transgenerational trauma. For example:



Intergenerational vs Transgenerational

Inheritance:

What's the difference?



Intergenerational epigenetic inheritance refers to changes in gene expression caused by parental exposure to a stressor when offspring cells are present in the body.

When a pregnant woman is exposed to a stressor, the fetus AND the egg and precursor sperm cells in the fetus are also directly exposed.



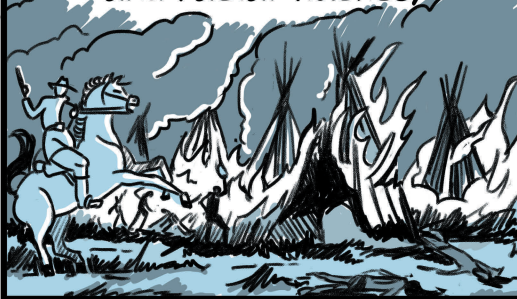
Transgenerational epigenetic inheritance refers to the altered gene expression in the generations after those that were "there" for the trauma.

The persisting effects of gross cultural oppression in Indigenous people is a perfect, horrific example of transgenerational trauma.

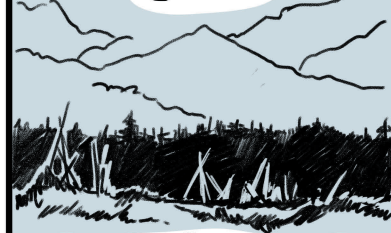
There is estimated to have been 50-150 million Indigenous people living in North America before 1492.



At the hands of endless wars and massacres, foreign disease, forced relocations and racial violence,



the population dwindled to 4 million by 1900.



The largest genocide in history.

In the campaign to wipe out Indigenous culture, the US and Canadian governments opened mandatory "Native Assimilation" Christian boarding schools.



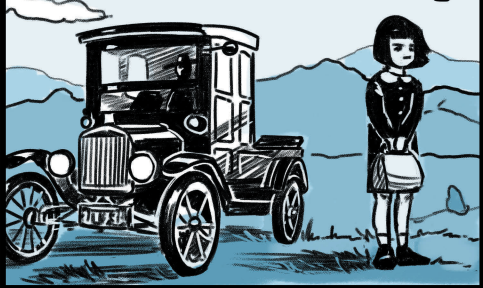
US schools forcibly housed 60,000 Indigenous children from 1860 to 1928.

Students were physically, sexually, mentally, emotionally, and spiritually abused.



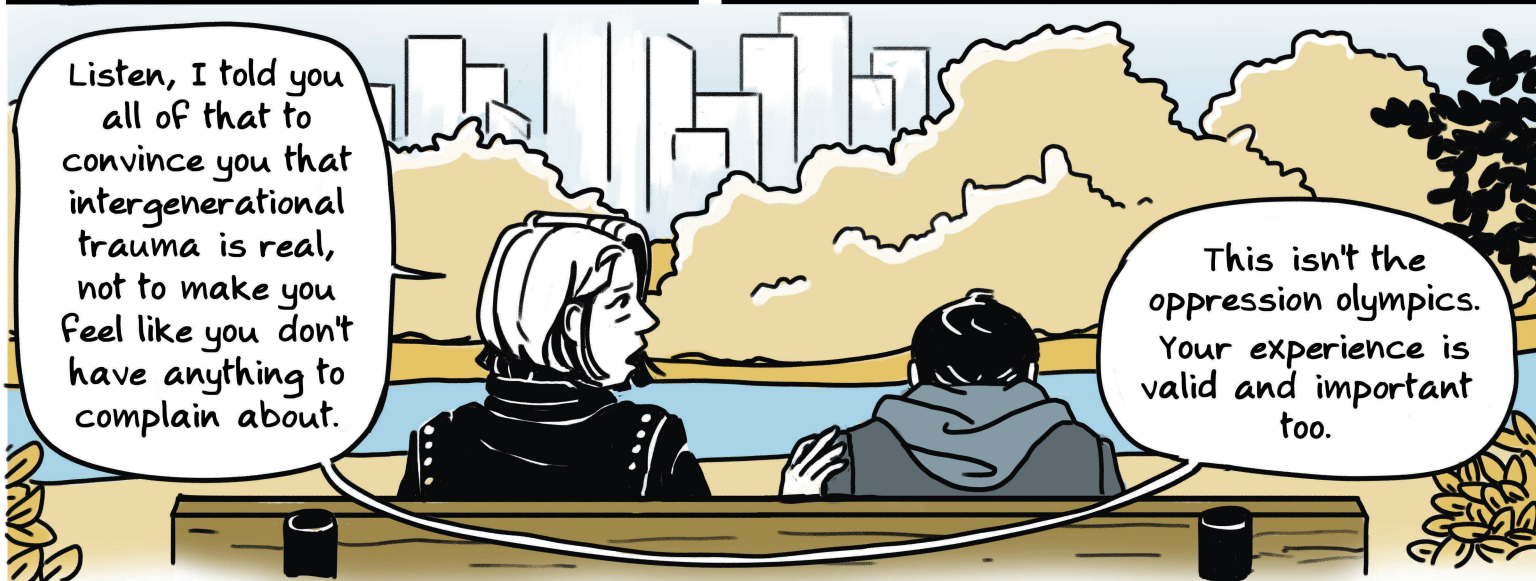
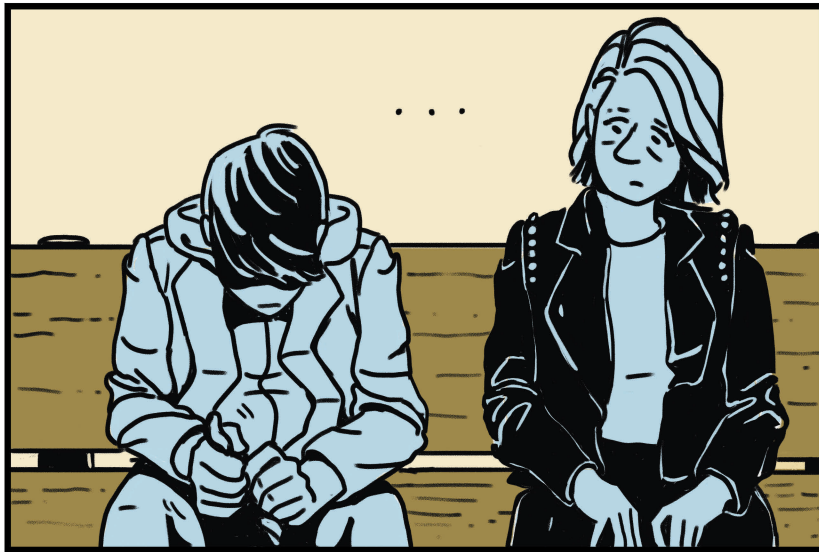
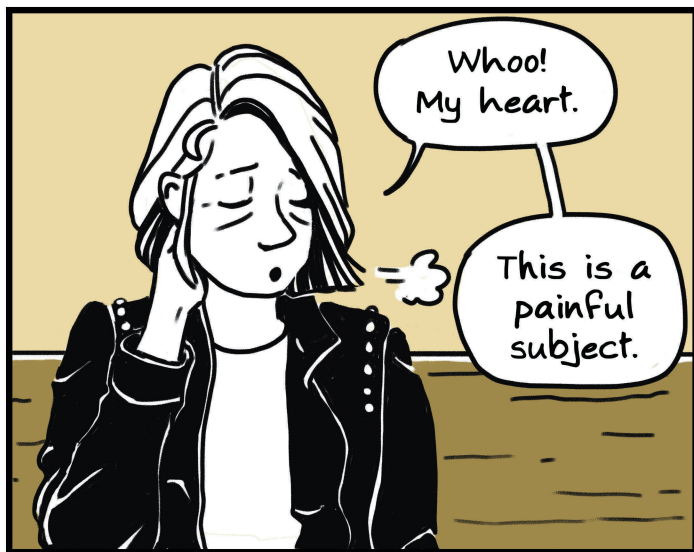
Thousands died from illness and mistreatment in awful conditions.

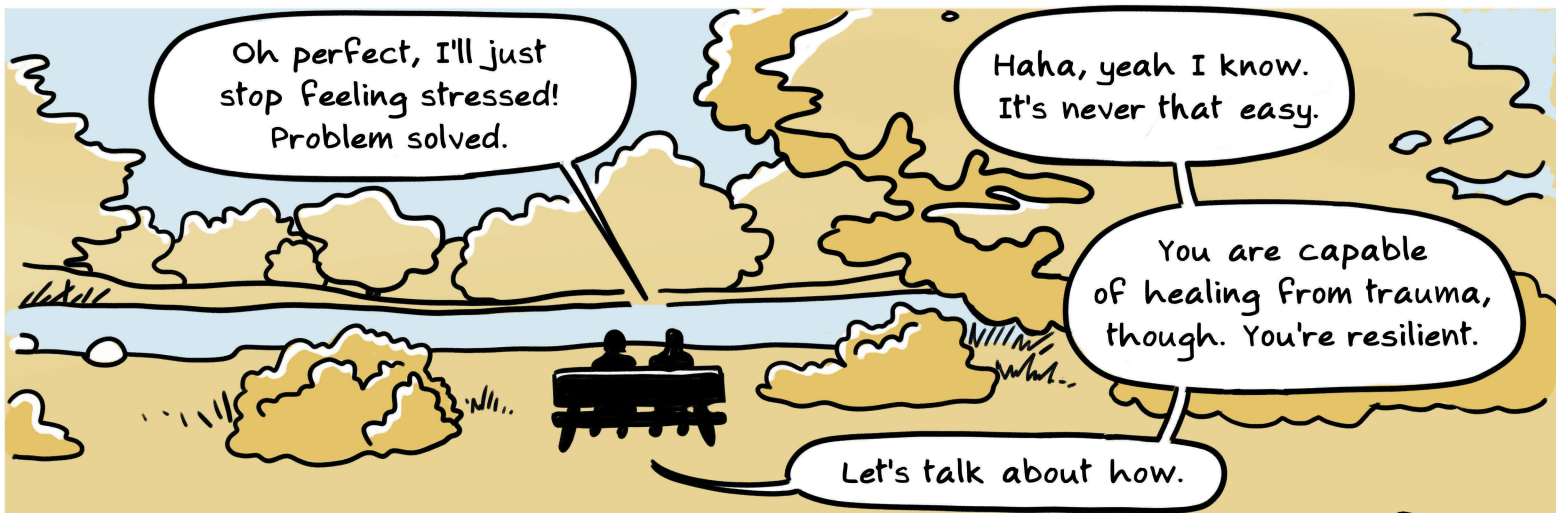
Survivors returned home permanently scarred by the abuse and loss of identity.



Generations later, Indigenous youth still carry the collective cultural trauma, suffering exceeding rates of:







A GUIDE FOR CYCLE BREAKERS

Semi-expert advice on healing from your family trauma and changing your gene expression.



STEP
1

Recognize your core trauma language.

What fears do you have that are connected to your past? To your family history?

What fears do you have that don't seem connected to anything that's happened to you? Maybe they didn't come from you. Maybe they started with someone in your family.



Once you figure out where your fear came from in the past, you can stop living with it like it belongs in the present.

STEP

2

Call your mom. Or your dad. Or your grandma.

Regardless of whether or not they are good at parenting, our parents are an inextricable part of us.

Being at peace with ourselves often begins with being at peace with our parents.



Don't expect your parents to be any different than who they are. Your trauma didn't start with you, but you have to be the one to heal it.

STEP

3

Get therapy.

Healing is really hard.

You don't have to do it alone.

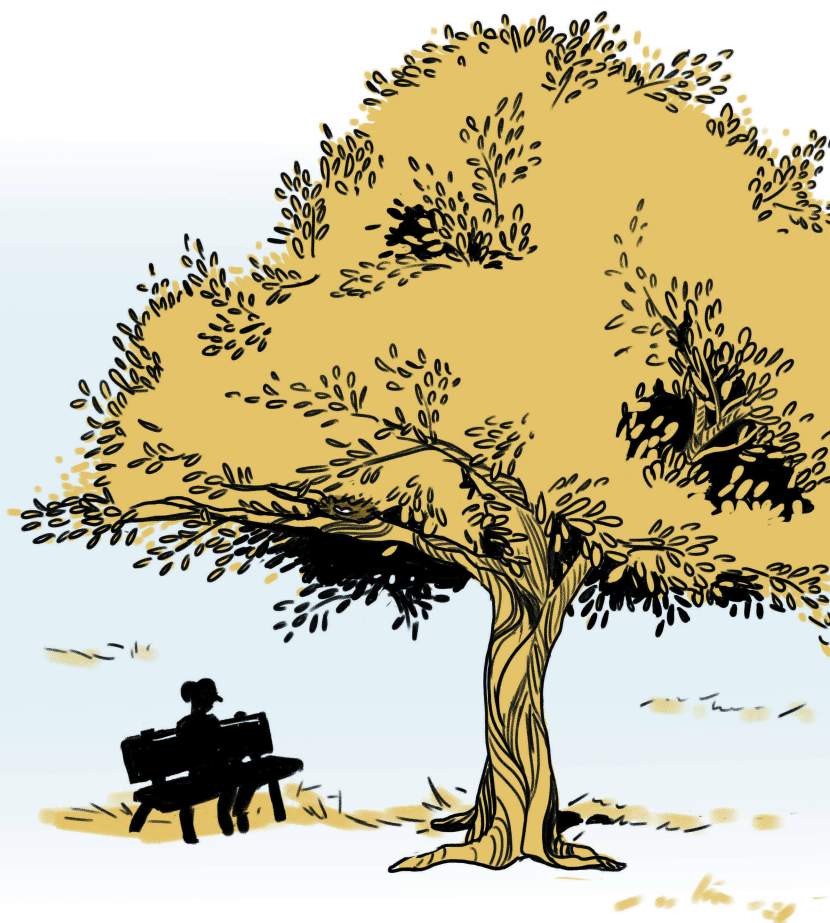
A therapist's support and insight makes a world of difference when you're trying to understand and heal yourself.

STEP

4

Focus on Love.

Remember that people love and support you. With repeated focused attention on thoughts of love, compassion, and well-being, you can create new neural pathways in your brain and reverse the effects of trauma in your genes.



A Note from the Author

Comics are wonderful for presenting information with efficiency and impact.

That means also that the information I didn't have space to include in this brief exploration of a complicated topic could and does fill full-length books. I am not a therapist, a psychologist, or a medical expert. All the knowledge I have, I gained from personal experience and from researching this comic.

I encourage you to read my sources further,

especially:

It Didn't Start With You:

How Inherited Family Trauma Shapes Who We Are and

How to End the Cycle by Mark Wolynn,

my source for most of the research and advice presented in this comic.

If this topic resonated with you,
I really recommend reading it for the full depth of
Wolynn's research and expert advice.

It sure as hell helped me.

Also available as an audiobook.



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About the Artist

At age 17, Lafleche Giasson escaped a cult and is now a lifetime later doing the real work of healing from it. Her comic work focuses on intergenerational trauma and compassionate storytelling.

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