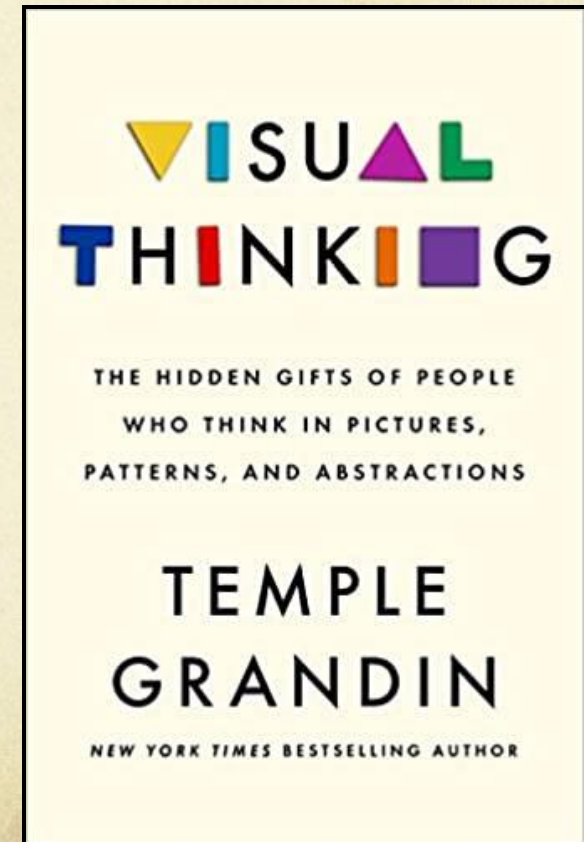


Great Minds Are Not All The Same, 3rd Edition

**Temple Grandin,
Distinguished
Professor of
Animal Science
Colorado State
University**



**We Need The Skills
of People Who Think
Differently**

- First Step is learning that different kinds of thinking exist
- I was shocked to learn that other people thought in words and did not think in pictures like me

Visual Thinking Helped Me In My Animal Behavior Work



I Looked At What Cattle Were Seeing



**I saw something that
should not be in the
launch pad that was a risk**



I Visualized The Raccoon Chewing on Wiring



Wikimedia

Different Approaches to Solving Problems

✓ Object Visualizers

See Risk

✓ Mathematicians

Calculate Risk

✓ Verbal Thinkers

Discuss Risk

3 Types of Different Ways of Thinking

Object Visualizer Thinks in Photo Realistic Pictures

Careers

- **Inventor of Mechanical Equipment**
- **Art-Graphic Design**
- **Photography**
- **Working With Animals**
- **Highly Skilled Trades, Welding, Car Repair, Electrician**

Object Visualizer Sees the Flower in the Metal Parts



Spatial Visualizer Thinks in Patterns

Careers

- **Computer Programming**
- **Engineering**
- **Chemistry - Physics**
- **Music**
- **Mathematics – Data Analytics**

Verbal Mind Thinks in Words

Careers

- **Writer**
- **Sales and Marketing**
- **Finance - Banking**
- **Psychologist**
- **Lawyer**
- **Teacher**

Groundbreaking Scientific Study Provides Scientific Evidence That Different Types of Thinking Exist

Kozhevnikov et al., 2002

Revising the Visualizer-Verbal
Dimension Evidence for Two Types
of Visualizers

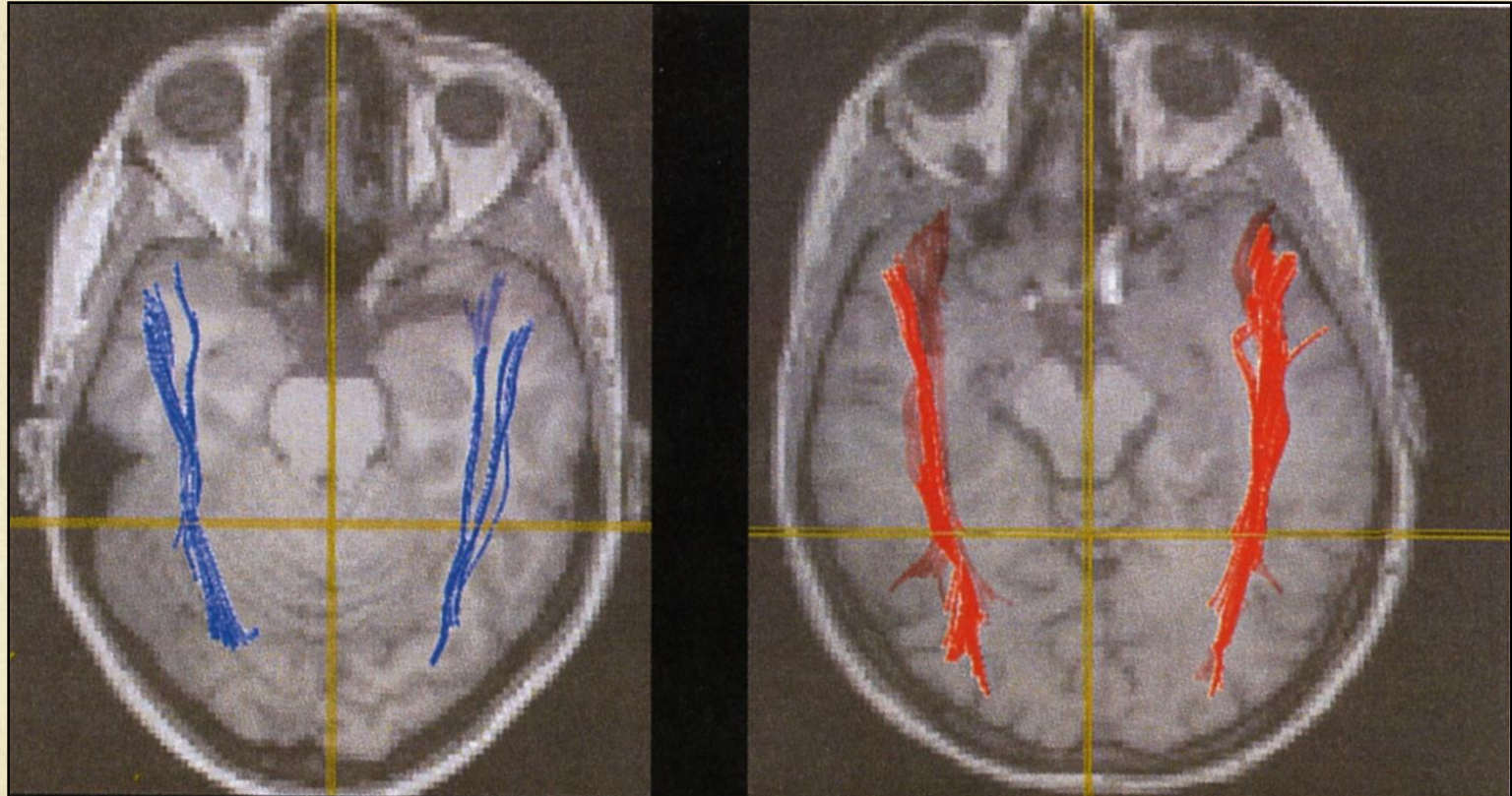
Cognition and Instruction,
Vol. 70(1):47-77

**Some People May Be
Mixtures of Different
Types of Thinking**

Brain Scans of Large Visual Thinking Circuit

Control

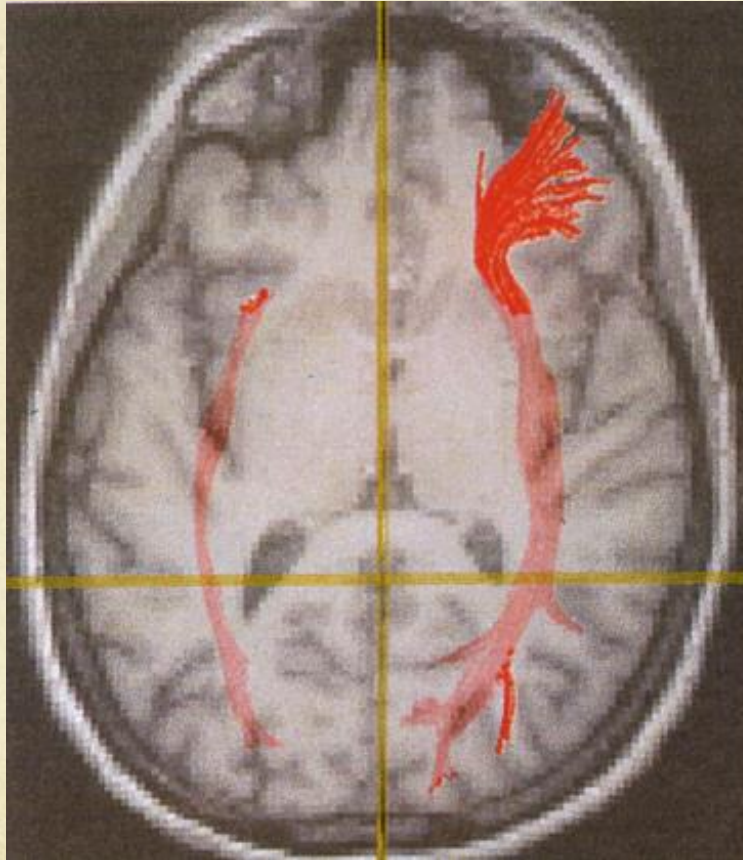
T. Grandin



Humphreys, Minshew, Behrmann, and Cibu, 2006

Brain Scans

T. Grandin



Control



Humphreys, Minshew, Behrmann, and Cibu, 2006

Eye Gaze Study For Preferred Sources of Information

- ✓ **Object Visualizer** looks at pictures
- ✓ **Verbal Thinker** looks at written text
- ✓ **Visual Spatial** looks at both

Create a Planet



Photo credit
NASA

- **Art students** made fantastic planets with pictures
- **Science students** made round planets lack imagery
- **Humanities students** used words and splashes of color
- **Art and science students** carefully planned their planets
- **Verbal thinkers** lacked planning

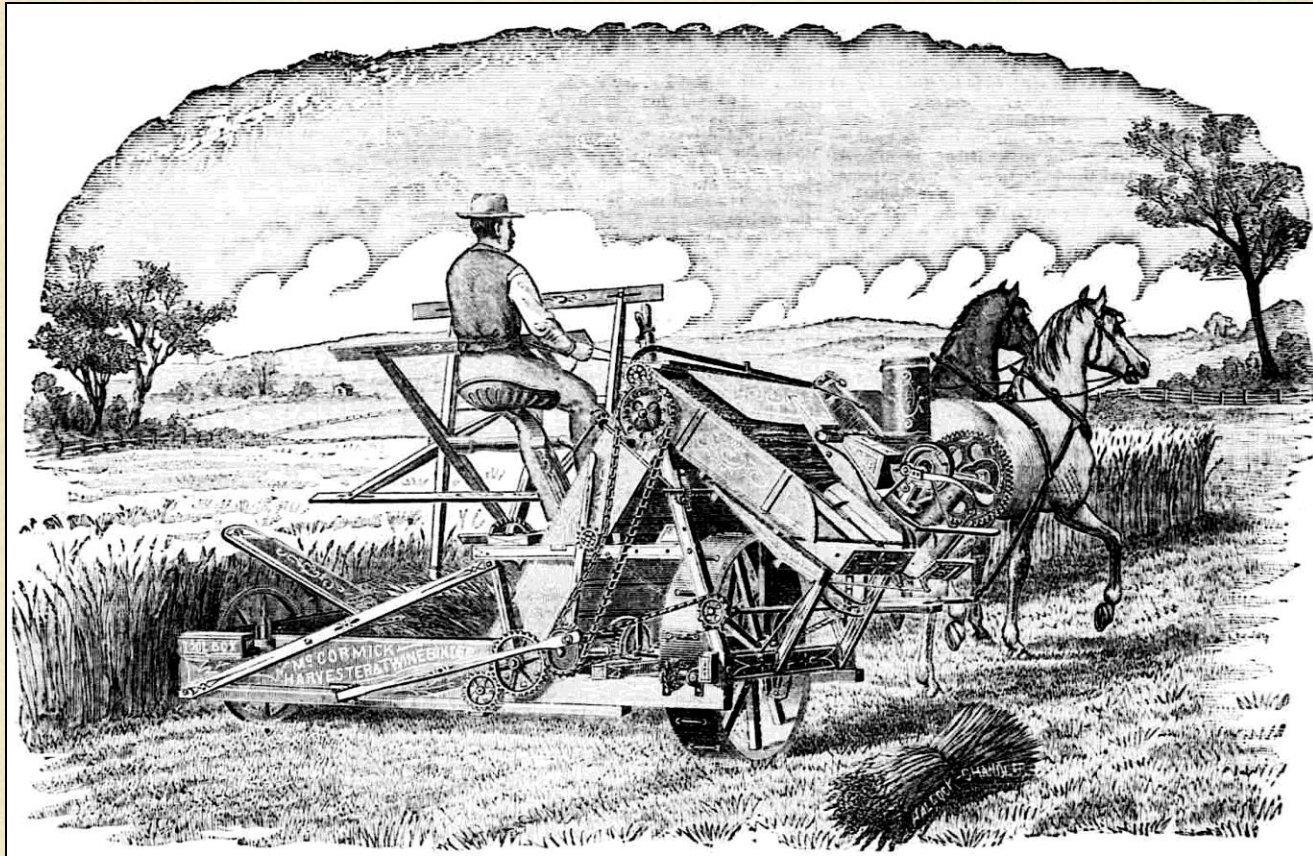
Blazhenkova and Kozhevnikov,
2016, 2020

➤ Verbal Thinkers

overgeneralized with top-down linear thinking that leaves out details

➤ Object Visualizers and Spatial Visualizers are bottom-up thinkers and keep too many details

Great Early Inventors, Such as Cyrus McCormick, Were Clever Engineers



Grain Harvesting Equipment in 1884

**Today We Don't
Make it Anymore!**

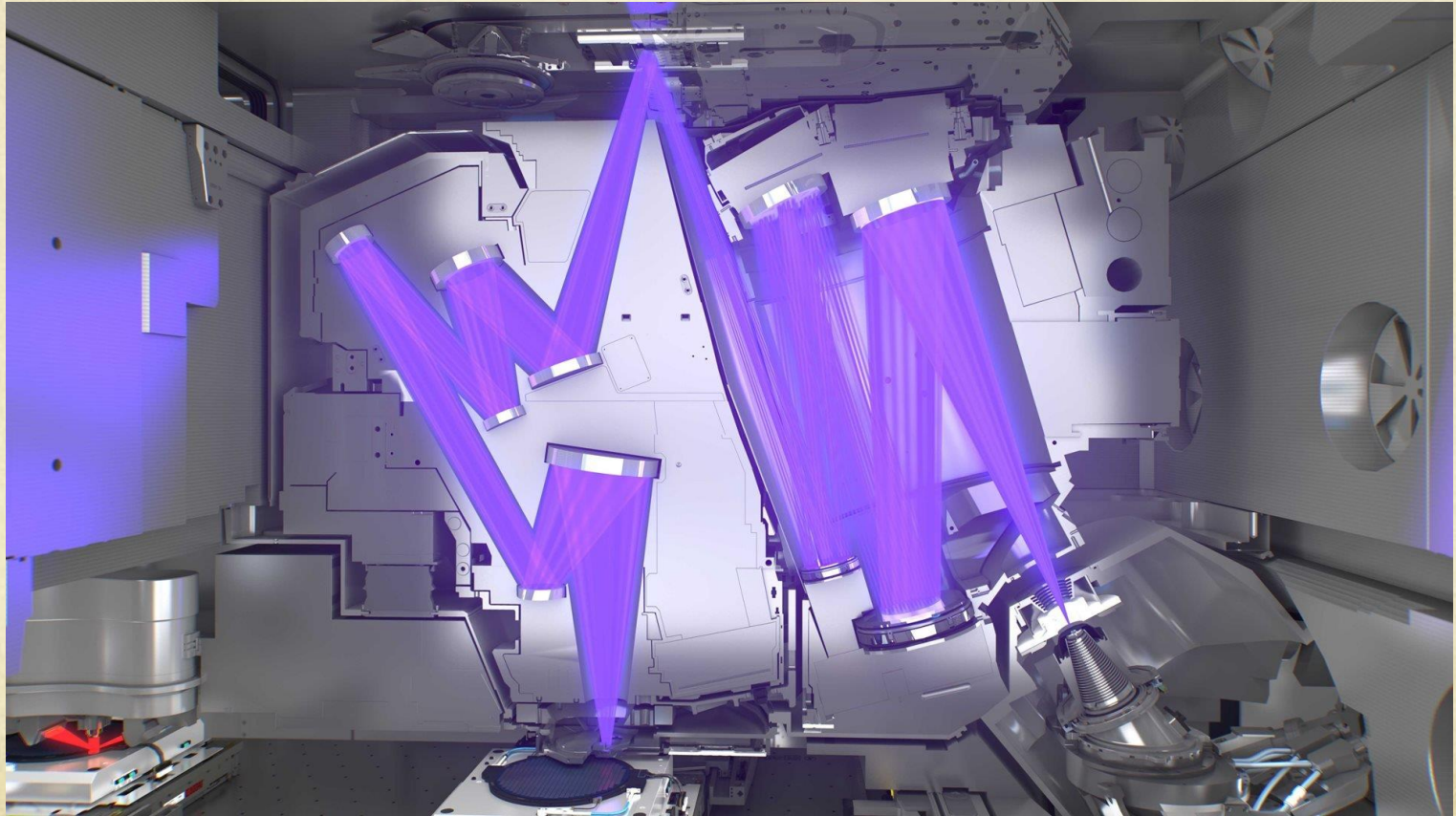
**Where are the
Clever Engineers?**

Today, Over Half of Large Industrial 3D Printers Sold To Industry Are European



Credit – Force Technology

State-of-the-Art Electronic Chip Making Machine From Holland





**Visual thinkers are
required to build this**

Source: ASML

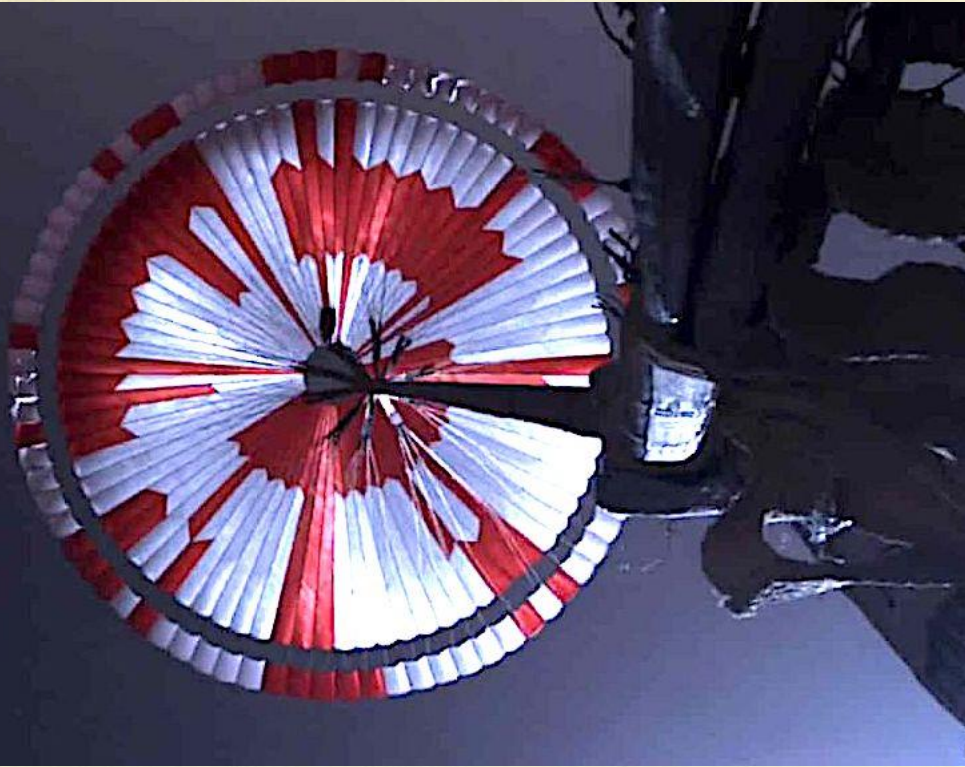


Newest Electron Microscope from Germany

We Have Lost the Skills to Build This



Mars Landing Parachutes



- ✓ Fabric made in the U.K., Sewn in the U.S.
- ✓ High tech looms from Europe

Dare Mighty Things

A Visit to the Mother Ship



We Paid The Price for Taking All the Hands-On Classes Out of the Schools Where Visual Thinkers Really Thrived

- Art, sewing, cooking
- Playing musical instruments
- Woodworking
- Welding – Create new devices
- Theater
- Auto shop

TACT Denver, Colorado



- 2-week trade exploration camp
- Small classes – 6 students
- Extensive job coaching when you begin employment

Autistic Actors in a Broadway Show



Grandfather Co-Invents Auto Pilot

Aug. 28, 1945.

J. C. PURVES ET AL

2,383,460

MAGNETIC FIELD RESPONSIVE DEVICE

Filed March 28, 1941

2 Sheets-Sheet 1

FIG. 1

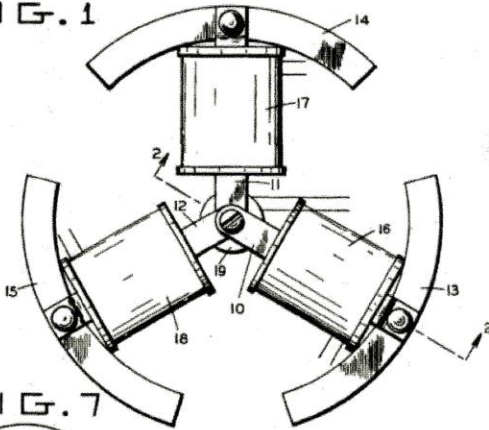


FIG. 7

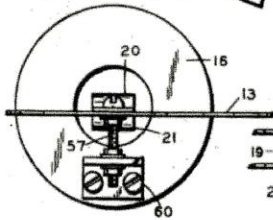


FIG. 2

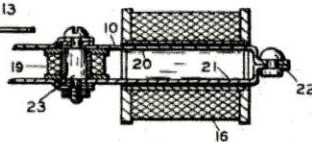


FIG. 8

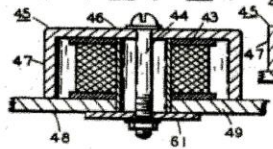
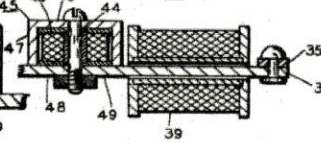


FIG. 4



INVENTORS
JOHN C. PURVES
LENNOX F. BRACH
BY *Herbert A. Thompson*
THEIR ATTORNEY.

Different Kinds of Minds Complemented Each Other

- Visual Thinker
- Mathematical Engineer
- A Verbal Thinking Lawyer would have prevented theft of their invention

Educational System is Screening Out Object Visualizers

- ✓ I could not do Algebra
 - ✓ Sixty percent of Community College students need remedial math
 - ✓ Only 30% need remedial English
-

The Owner is a Brilliant Object Visualizer Who Cannot Do Algebra



He is a Mechanical Genius Who Designs and Builds Hydraulic Power Systems



Autistic and Dyslexic People Worked with Me on the Center Track Restrainer That is Used in Large Beef Plants



Collaboration Required to Build Large Food Processing Plants?

- ❑ **Object visualizer Picture Thinkers** – Design plant layout and invent highly specialized mechanical equipment
- ❑ **Visual Spatial Math Thinkers** – Engineer, boilers, refrigeration, calculate roof trusses, power and water

Huge shortage of electricians, mechanics, and welders who can read drawings.

Collaboration on the Book Visual Thinking

- I wrote the first drafts by associating pictures
 - Betsy Lerner re-organized my thoughts with her linear verbal thinking
 - Together we kept the right amount of detail
-

Collaboration Required to Construct Buildings

Object Visualizers

Architects

- Creativity
- Appearance
- Big Picture
- Aesthetics

Spatial Visualizers

Engineers

- Safety
- Electrical Mechanical Systems
- Structural Loads
- Functionality

Twenty Percent of People I Worked With Were Either Autistic, Dyslexic or ADHD

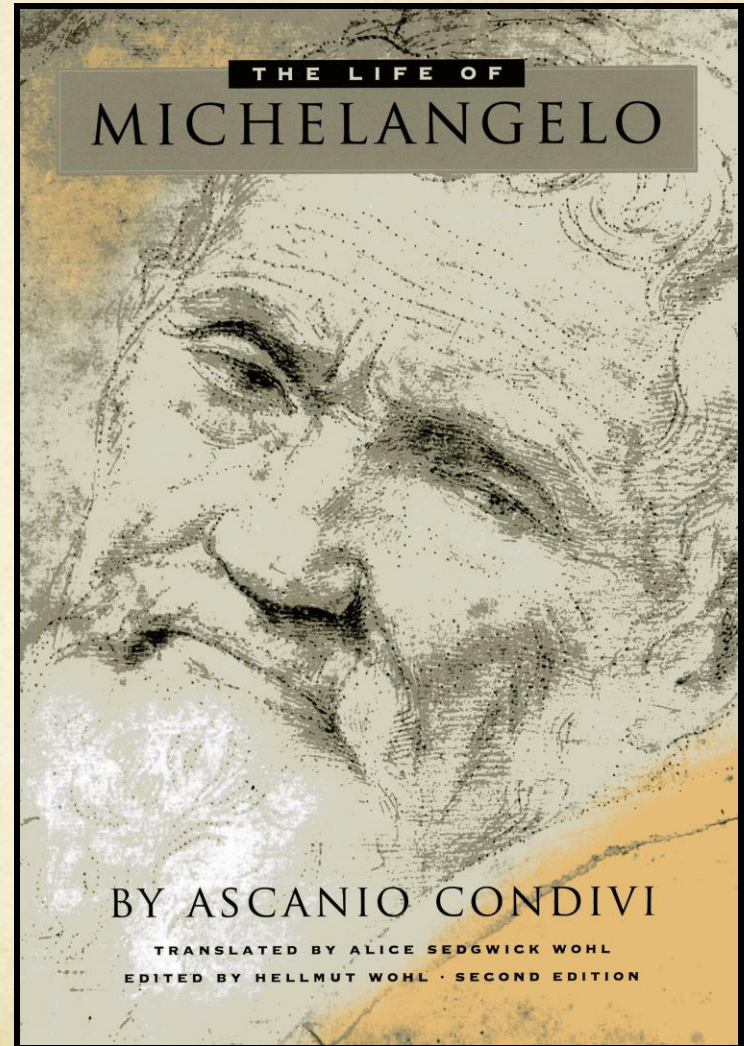
- ✓ Owned metal companies
 - ✓ Multiple patents
 - ✓ Designed and built complex mechanical equipment
 - ✓ Most of them were poor at algebra
-

-
- Grandparents and parents often tell me they have autism after a child was diagnosed
 - Most had successful careers. Learned work skills as children
 - Diagnosis helps fully verbal teens and adults with relationships
-

-
- What would happen to top innovators in today's educational system or workplace?
 - Many of them had an unconventional educational path
 - If born today, would their lives have been less successful?
-

Michelangelo

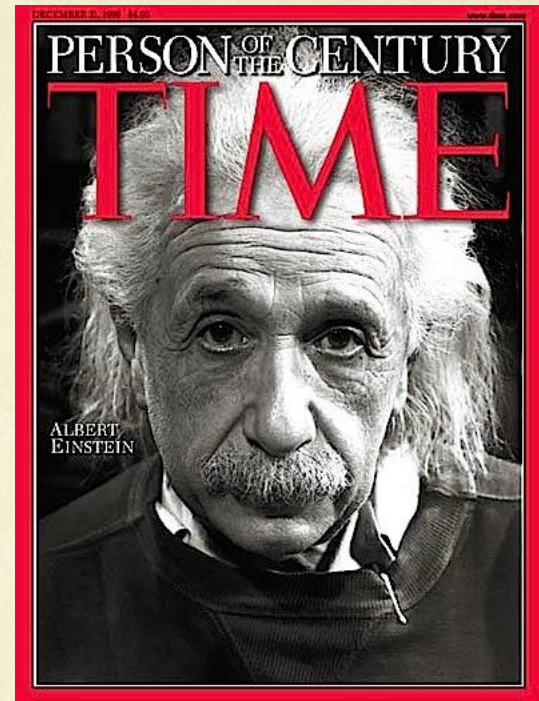
- Dropped out of school at age 12
- Exposed to both art and stone cutting tools
- Mentoring occurred after exposure got him started



These Innovators Had Creative Hobbies

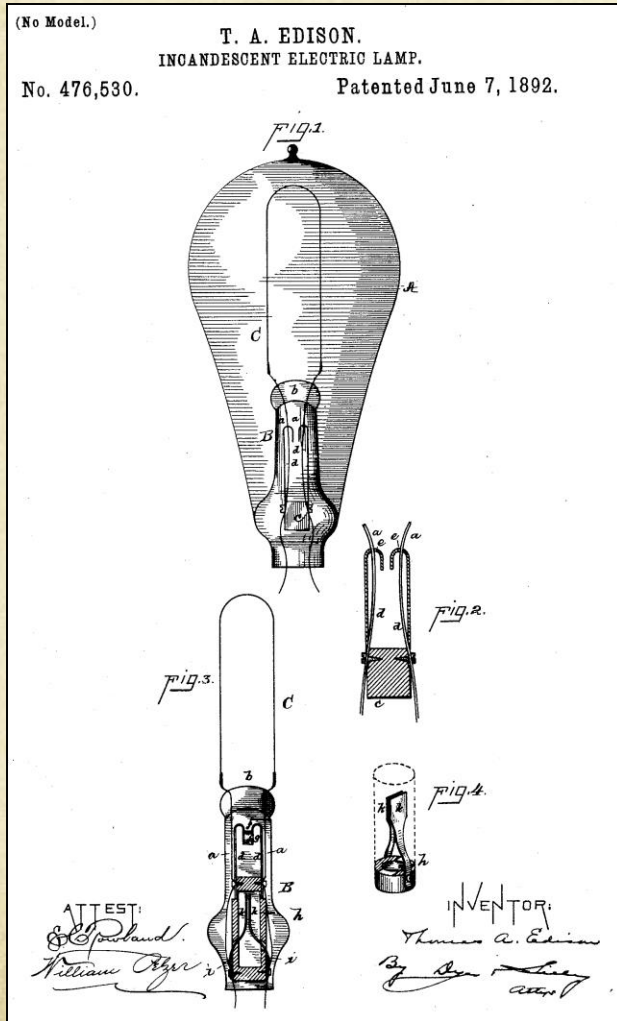


Bullied in school
Learned calligraphy
Tinkered in a neighbor's garage



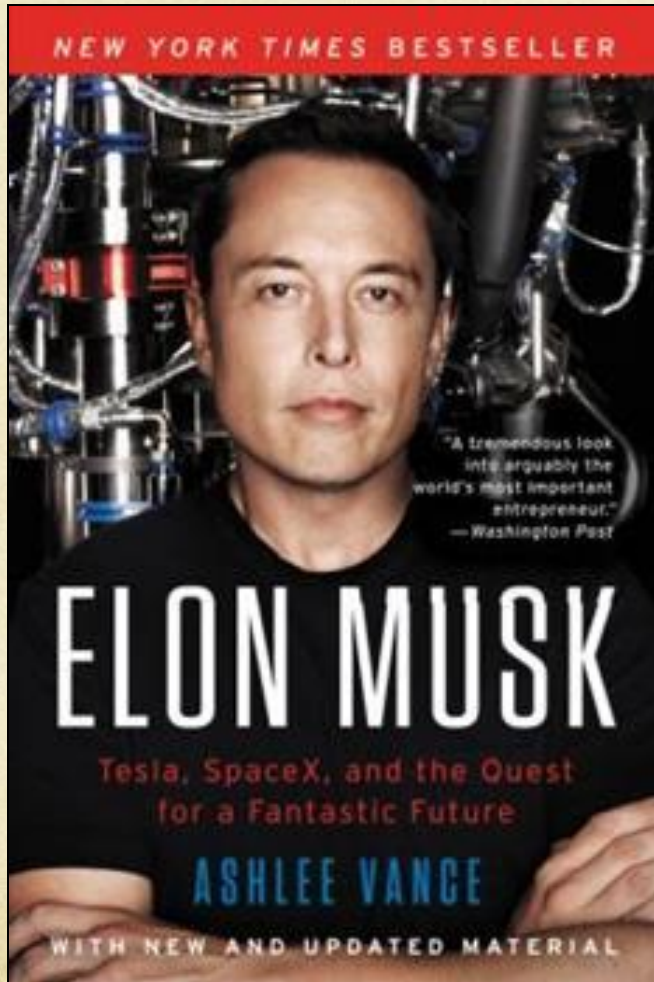
No speech until age 3
Played the violin

Thomas Edison



- High School drop out
- Probably had autism
- Learned how to work
- Mentored in New Technology

Elon Musk



- ✓ SpaceX
- ✓ Tesla Electric Car
- ✓ Bullied in school
- ✓ Is on the autism spectrum

Arts Foster Scientific Success

- Nobel prize winners 50% more likely to have an arts and craft hobby compared to other scientists
- They were painters, musicians, actors, dancers, composers, poets, photographers or craftsman

Robert Root Bernstein et al., 2008

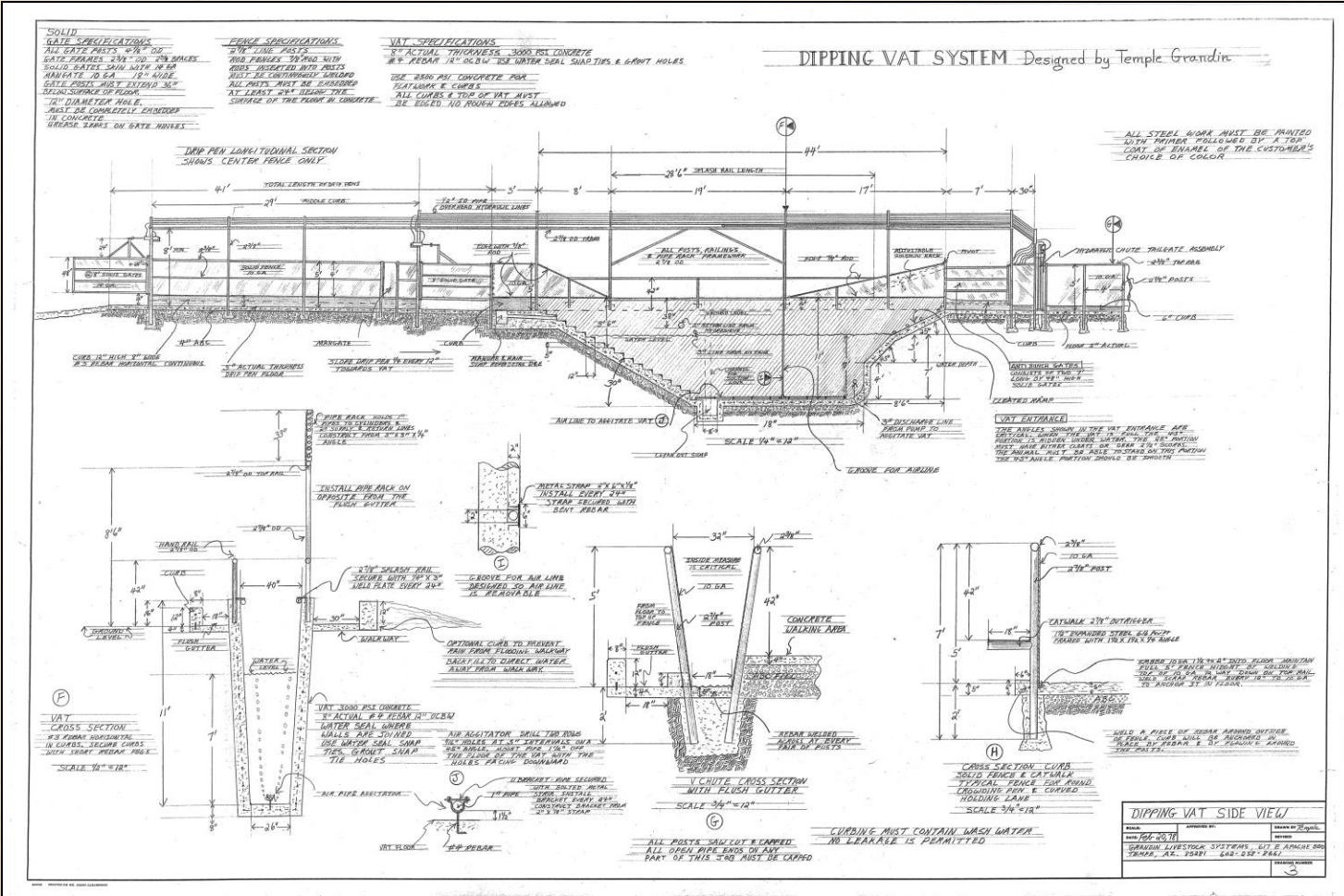
Tips for Working with Minds That are Different

- ✓ Never overload working memory with rapid multi-tasking
- ✓ Provide a written Pilot's Checklist for tasks with multiple steps. It is an external working memory
- ✓ Avoid long strips of verbal instruction
- ✓ Stretch them slightly out of their comfort zones
- ✓ Limit video games and replace with mechanics
- ✓ Provide choices of hands-on activities
- ✓ Do not use vague instructions

Ultimate Goal of Education

- Where is a student ten years after high school graduation?
 - I was doing my first big livestock design projects
-

Sold My Work By Showing My Portfolio



An Interview For Me Was Showing The Client Photos and Drawings



Replica Used in HBO Movie *Temple Grandin*



Put it on
your phone

30 Second
WOW

LIVESTOCK HANDLING SYSTEMS

A Well Designed Facility will help make your
Livestock Operation More Profitable.

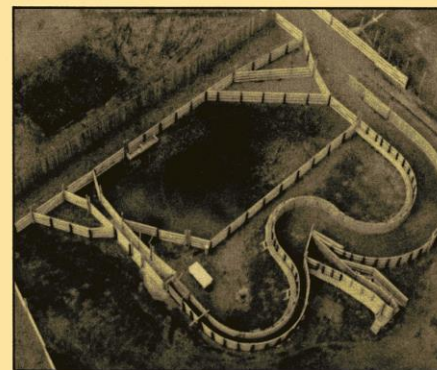


CUSTOM DESIGNED To Fit Your Operation:

Working, sorting, loading and hospital facility at A. Glenn Kluck Feedlots in Richland, Nebraska. The system has a curved level loading chute, herringbone sorting pens, scale, covered hospital pens, working circle and horse pens. Curved chutes and smooth traffic flow reduce stress and improve efficiency. The covered working circle is designed for easy washdown. Employees will do a better job of processing in clean facilities which protect them from the weather. Careful gentle processing will improve cattle performance.

CURVED WORKING CHUTES For Greater Efficiency:

A curved single file chute, round crowding pen and wide curved alley are labor saving and reduce stress at Alan Verishine's cow calf operation in Saskatoon, Canada. A handler working from the catwalk along the inner radius can move cattle easily into the round crowd pen and squeeze. Cattle can be sorted 3 ways after the squeeze chute. Grandin designs handling facilities for all types of ranch and feedlot operations.



Consultant & Designer of livestock handling facilities for feed lots, ranches, packing plants & auctions.

GRANDIN LIVESTOCK HANDLING SYSTEMS, INC.

Suite 3, 1401 Silver St.
Urbana, IL 61801 217-384-4815

NEW ADDRESS:

1205 W. Elizabeth Suite E122
Fort Collins, CO 80521

Half the Cattle in North America are Handled in Systems I Designed



Get Lots of Exercise

**I do 100 sit-ups
every night**

My Work Experience

- ❑ 13 years of age - Sewing job
- ❑ 15 years of age – Cleaning horse stalls
- ❑ 16 years of age – Aunt's ranch
- ❑ 16 years of age – Roofing
- ❑ 17 years of age – Sign painting
- ❑ College – Research Lab – Rent houses
- ❑ College – Aid Child With Autism

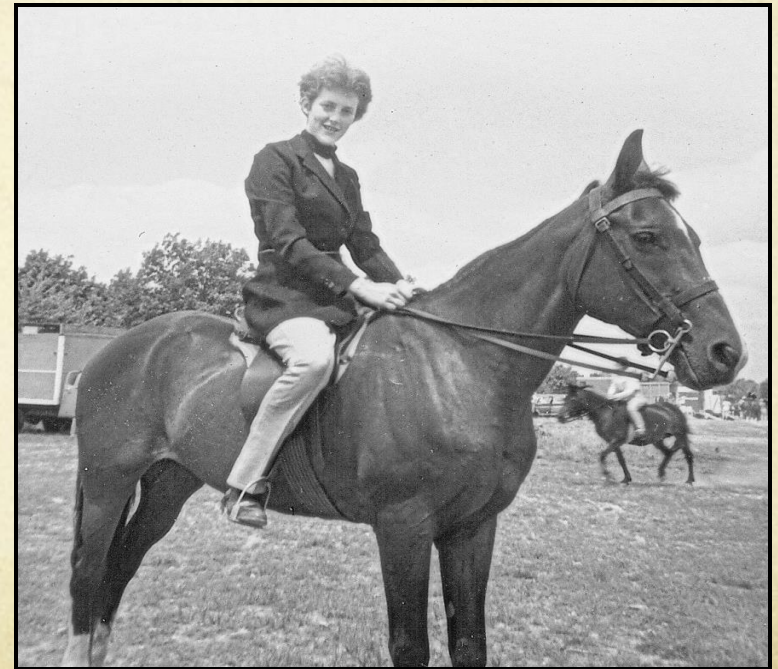
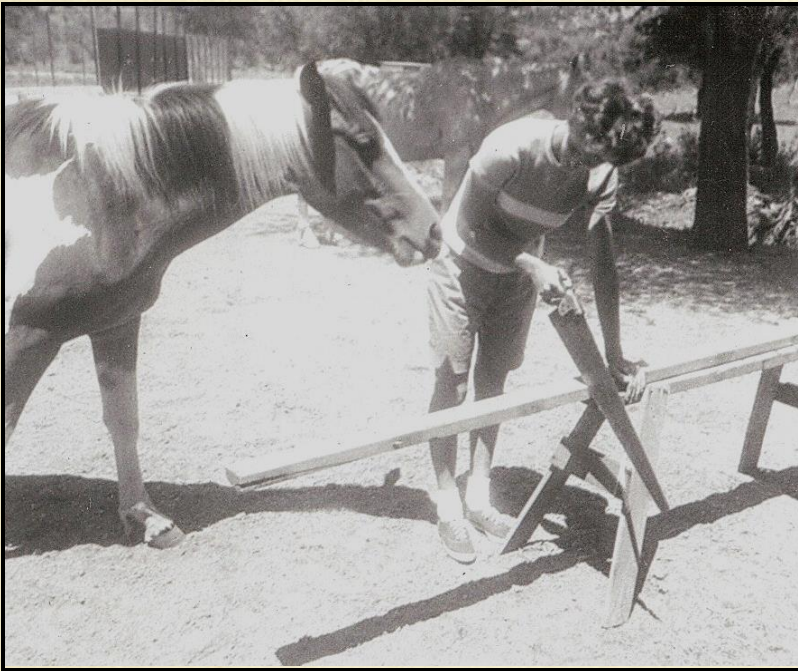
Find Back Doors to Jobs

- ✓ Friend's Business
 - ✓ Contacts in Your Industry
 - ✓ Half of All Good Jobs Back Door
-

My Elementary School Life Skills Training

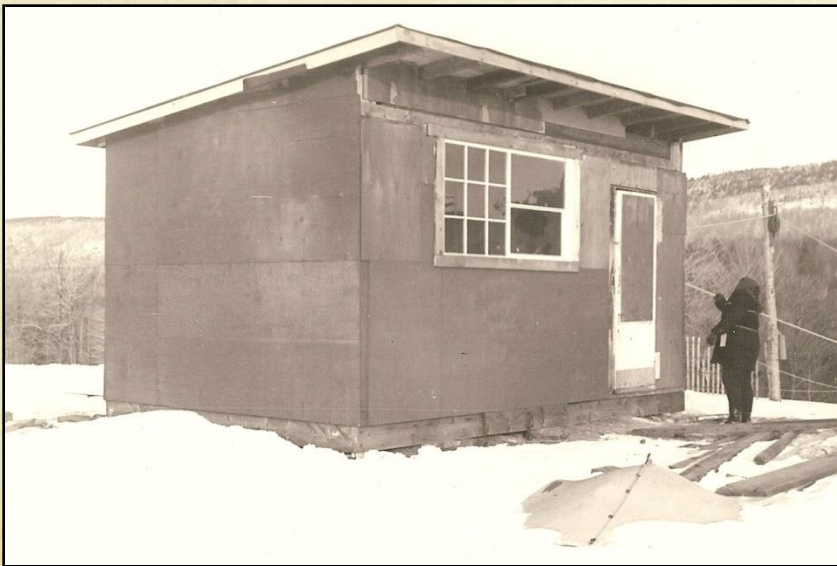
- Party hostess at family parties and shake hands with guests
- Sold candy to neighbors for charity
- Shopped by myself for small toys and snacks
- Learned saving money

Friends Through Shared Interests in Art, Carpentry, and Horses

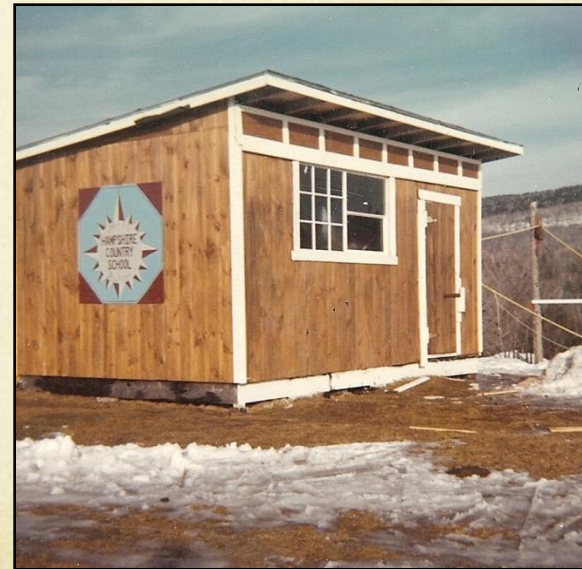


I was a poor student but I learned lots of valuable work skills in high school. I did building projects that other people appreciated

Before



After



Freelance Sign Painting at the Carnival



Photo by Leo

Driving Slow and Gradual Approach

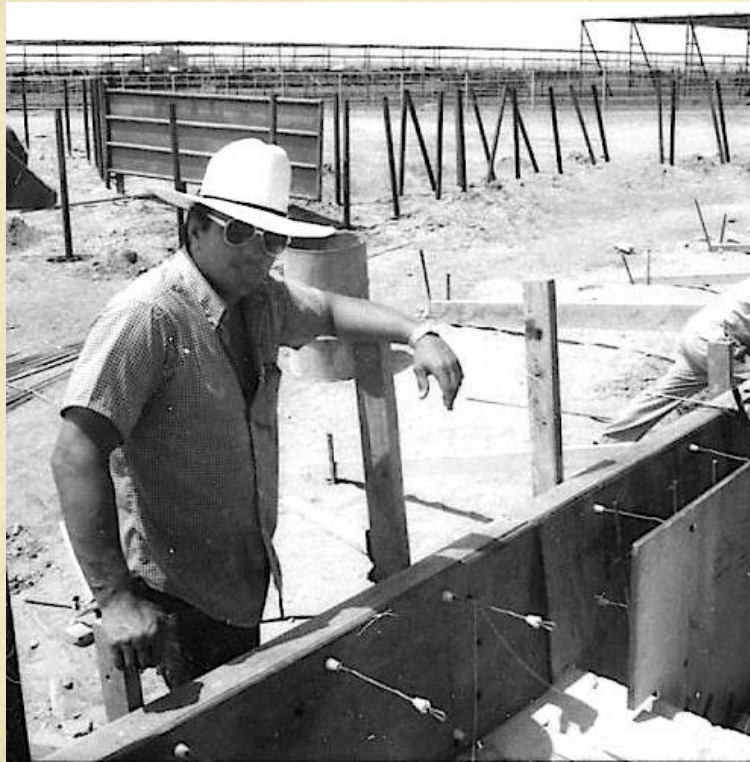


Kristina et al., 2018

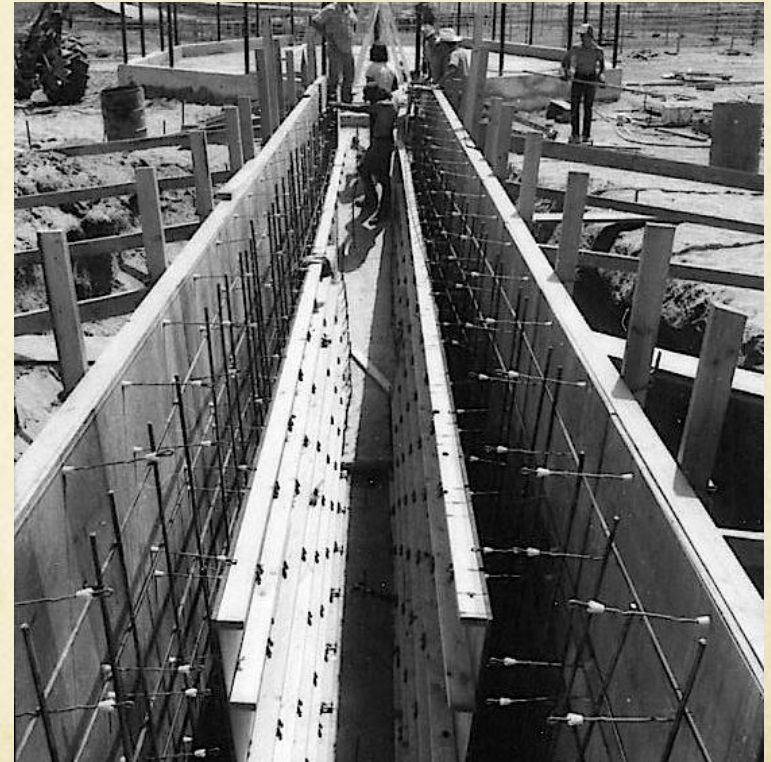
Slow Transition to the World of Work

- Jobs on a schedule outside the home at age 11 to 12
 - Learn basic life skills such as shopping
 - Do not overprotect or over accommodate
 - Learn to keep a real job before graduation from high school
-

Jim Uhl, the Contractor – An Important Work Mentor



Got on the Phone Fast to Find the Drawings for This



Finding Mentors and Teachers

- ❑ My Mother – Taught me to read at age 8
 - ❑ Elementary School Teachers
 - ❑ Mr. Carlock, High School Science Teacher
 - ❑ Jim Uhl – Agate Construction
-

Sensory Over Sensitivity

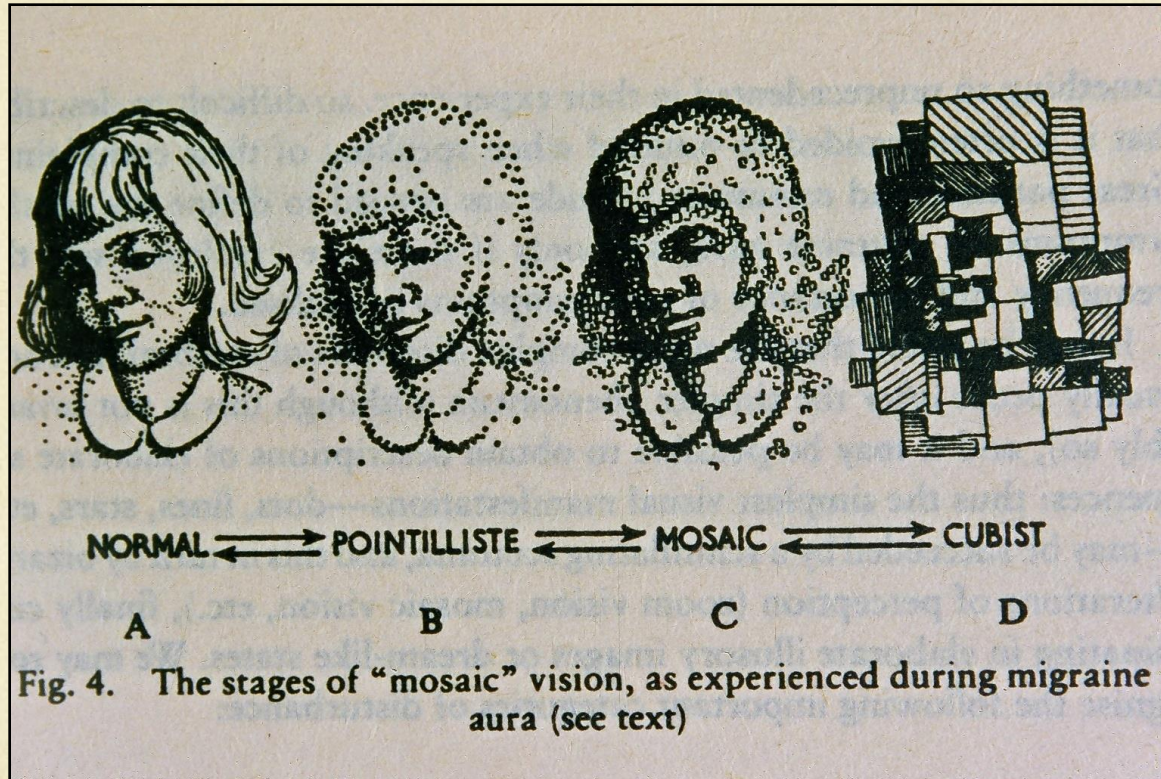
- Highly variable
- Give the individual control of the sound they hate
- Do not wear headphones all the time because they will make sound sensitivity worse
- Thrift shops have soft clothing
- Autism Environmental Enrichment

Signs of Visual Processing Problems in Autism, Dyslexia, and Sensory Processing Disorder

- ✓ Hates escalators
- ✓ Print jiggles on the page during reading
- ✓ Eye exam may be normal



Visual images break up and fragment similar to migraine headaches



Oliver Sacks

Words vibrate and jiggle on page

. Trends in Neurosciece, Vol. 20, pp. 147-152, 1997

PERSPECTIVES J. Stein and V. Walsh – Temporal processing and dyslexia

Worbs ~~can be~~ hard to read for several different reasons

Fig. 1. *Words can be hard to read for several different reasons. Visual confusions can cause letter reversals ('worbs'), distortion and blurring ('can be hard to read') and superimposition ('for several different').*

Dyslexia is caused by defects in brain circuits which process fast moving auditory and visual information. Reading and doing number work with one eye may improve reading and help stabilize abnormal eye movements.

Interventions for Visual Processing Problems

Non-flickering LED lamp by desk or natural light



Block flicking LED lights with a hat



Locate flickering LEDs and screens with slow motion video



Gray, tan, or pastel paper for reading

Irlen lenses or pale colored glasses



Severe Sensory Problems

- Extreme effort required to screen out background noise and visual distractions
- Needs frequent breaks to prevent sensory overload
- Mono-channel – Eye contact may be difficult
- Body boundary problems
- Often an auditory thinker

Environmental Enrichment is an Effective Treatment for Autism

- ✓ Stimulate two senses simultaneously
 - ✓ Adjunct to ABA and speech therapy
 - ✓ One of the senses is always smell or touch
 - ✓ Novelty and keep changing the stimulation
 - ✓ Use simple economical things. Two 15 minute sessions per day
-

Nonverbal Individuals who Type Independently Describe Severe Sensory Problems

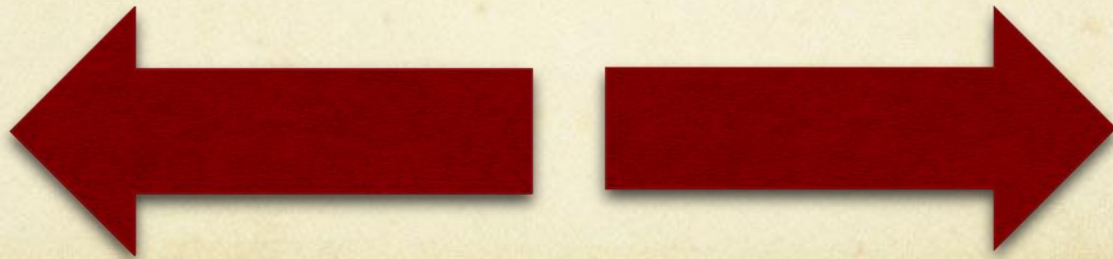
- ❑ *How Can I Talk if my Lips Don't Move* by Tito Rajarish Muhopadhyay
- ❑ *Carly's Voice* by Arthur Fleischmann with Carly Fleischmann
- ❑ *The Reason I Jump* by Naoki Higashida
- ❑ *Fall Down 7 Times Get up 8* by Naoki Higashida

Slow Processing Speed Explains Difficulty With:

- Rapid conversation
- Rapid multi-tasking
- Rapid response to a question
- Remembering long verbal instructions
- Problems with interrupting conversations

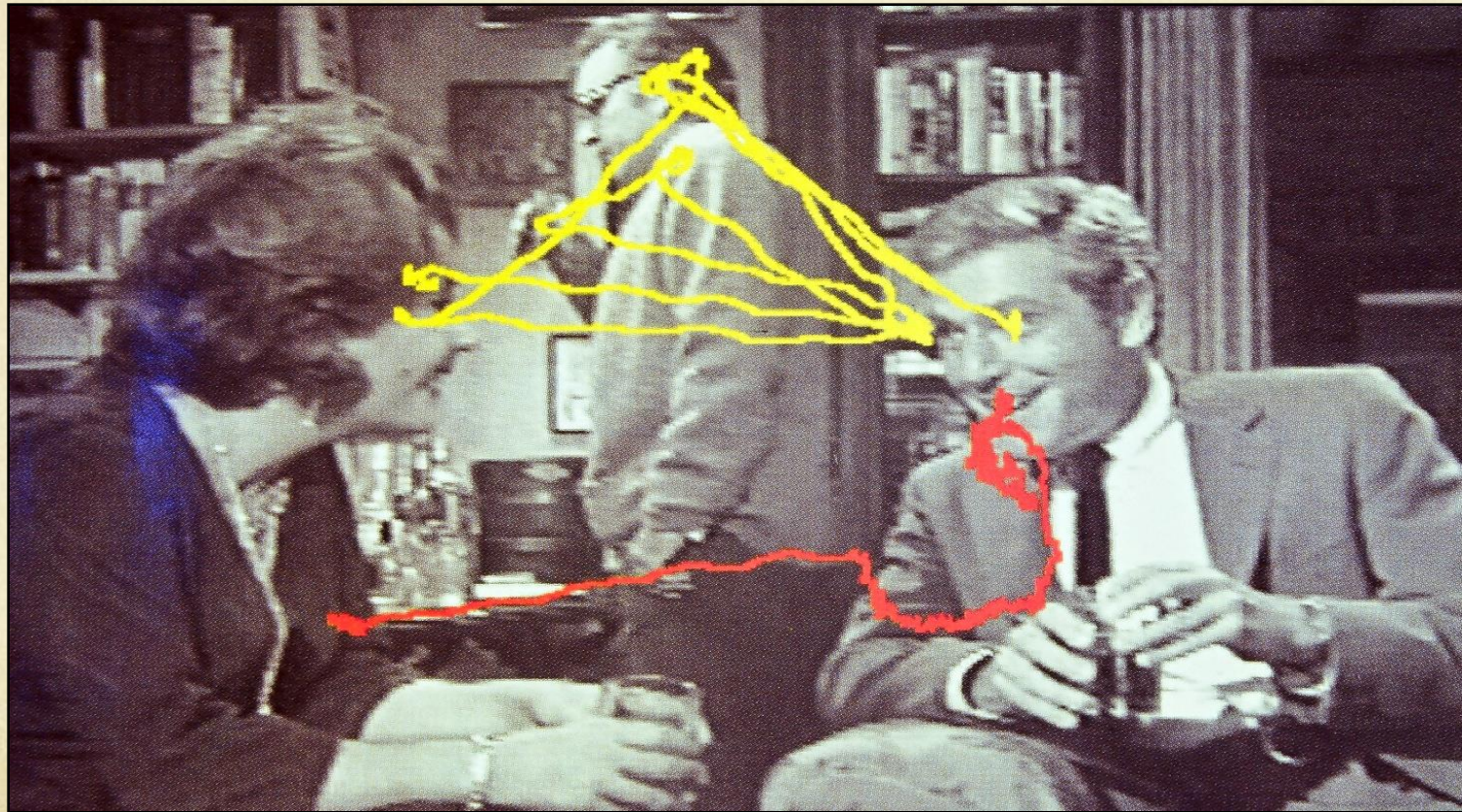
Attention shifting slowness
occurs with many disorders

Takes longer to shift back
and forth between
two different things



Slow Processing Speed

Viewer with Autism (Red Line)
Normal Comparison Viewer (Yellow Line)
Shows Attention Shifting Slowness

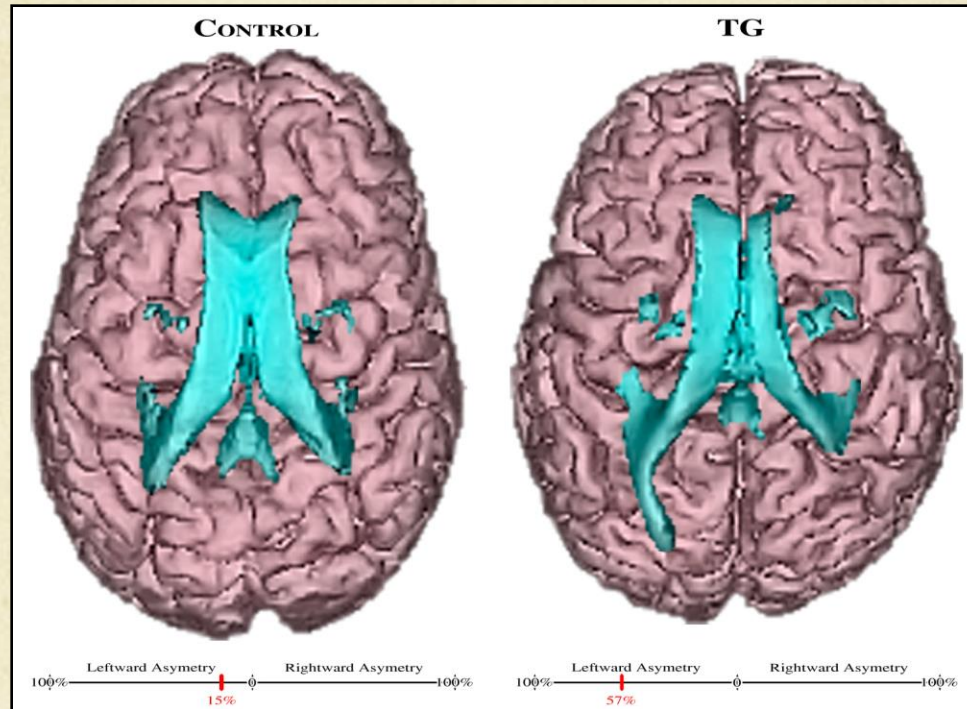


Ami Klin

Teaching Young Kids

- Slow down when you talk
 - Encourage use of words
 - Give them more time to respond
 - Use teachable moments
 - Give instruction instead of saying *No*
 - Teach turn taking so kids learn to wait
-

Abnormalities in Left Hemisphere



Working Memory and Algebra
Department Failed to Develop

University of Utah, 2010

**Fear is the main
emotion in Autism. My
amygdala (fear center)
is three times larger.**

University of Utah, 2010

Things I was Afraid of in My 20's

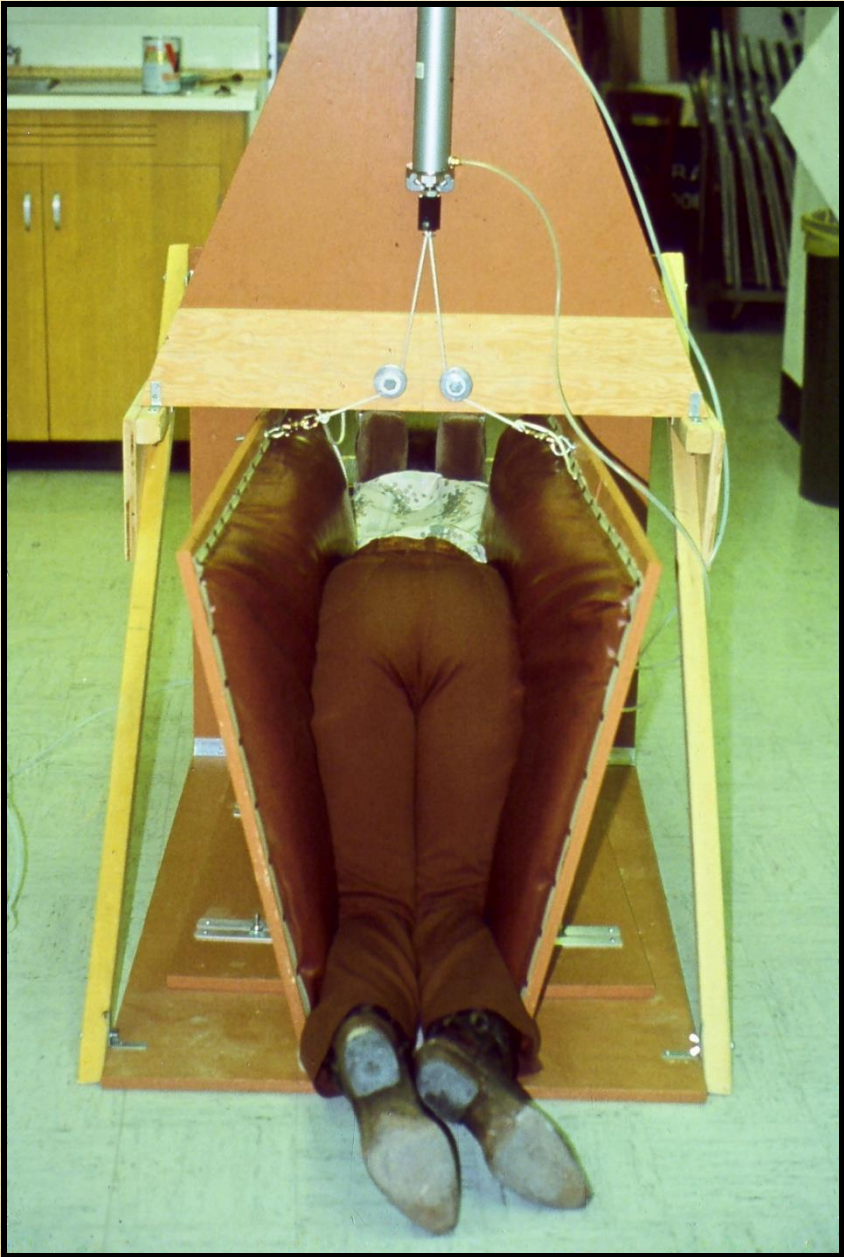
- ✓ Airplanes
- ✓ Public speaking – walked out during my first talk



Got Over It When an Airplane Became Interesting



- Fear is the main emotion in autism. My amygdala (fear center) is three times larger (University of Utah, 2010)
- A low doses of antidepressant has controlled my anxiety – Started early 30's
- *Thinking in Pictures* – Chapter “A Believer in Biochemistry”
- High doses of antidepressants may cause insomnia or agitation



Using pressure to calm the nervous system during therapy

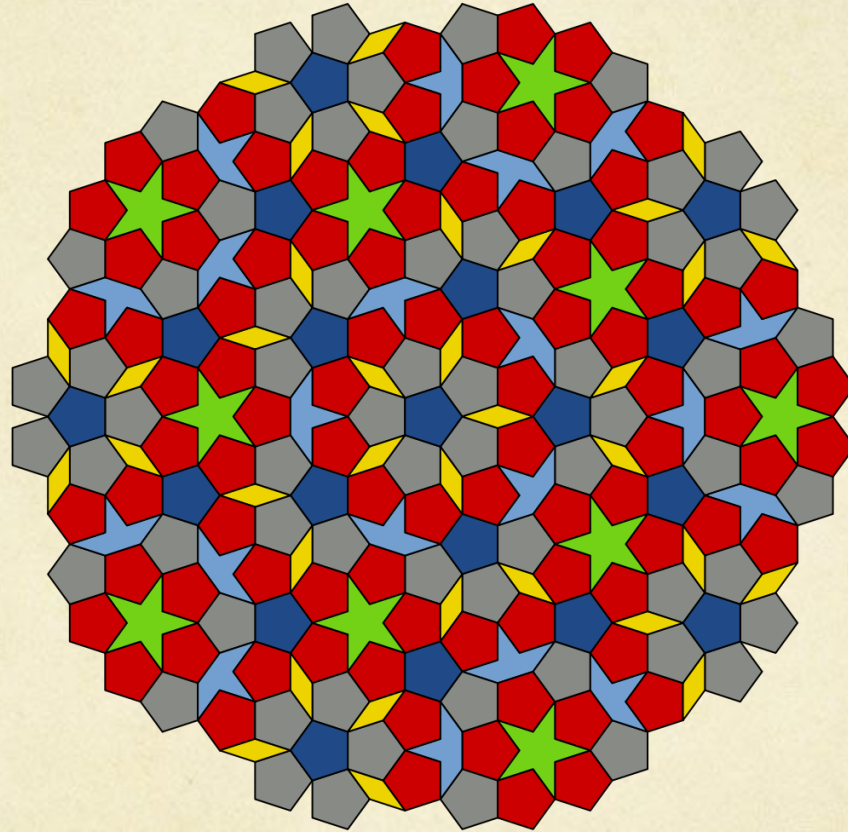


Show Kids Interesting Things



Put business and science magazines
in the school library

Penrose Tiling



Credit: Wikimedia

**Experimental Huntington
drug brings rare hope** *p. 742*

Tomorrow's Earth
pp. 748, 751, & 766

**Gene linked to immune
dysfunction** *pp. 756 & 810*

Science

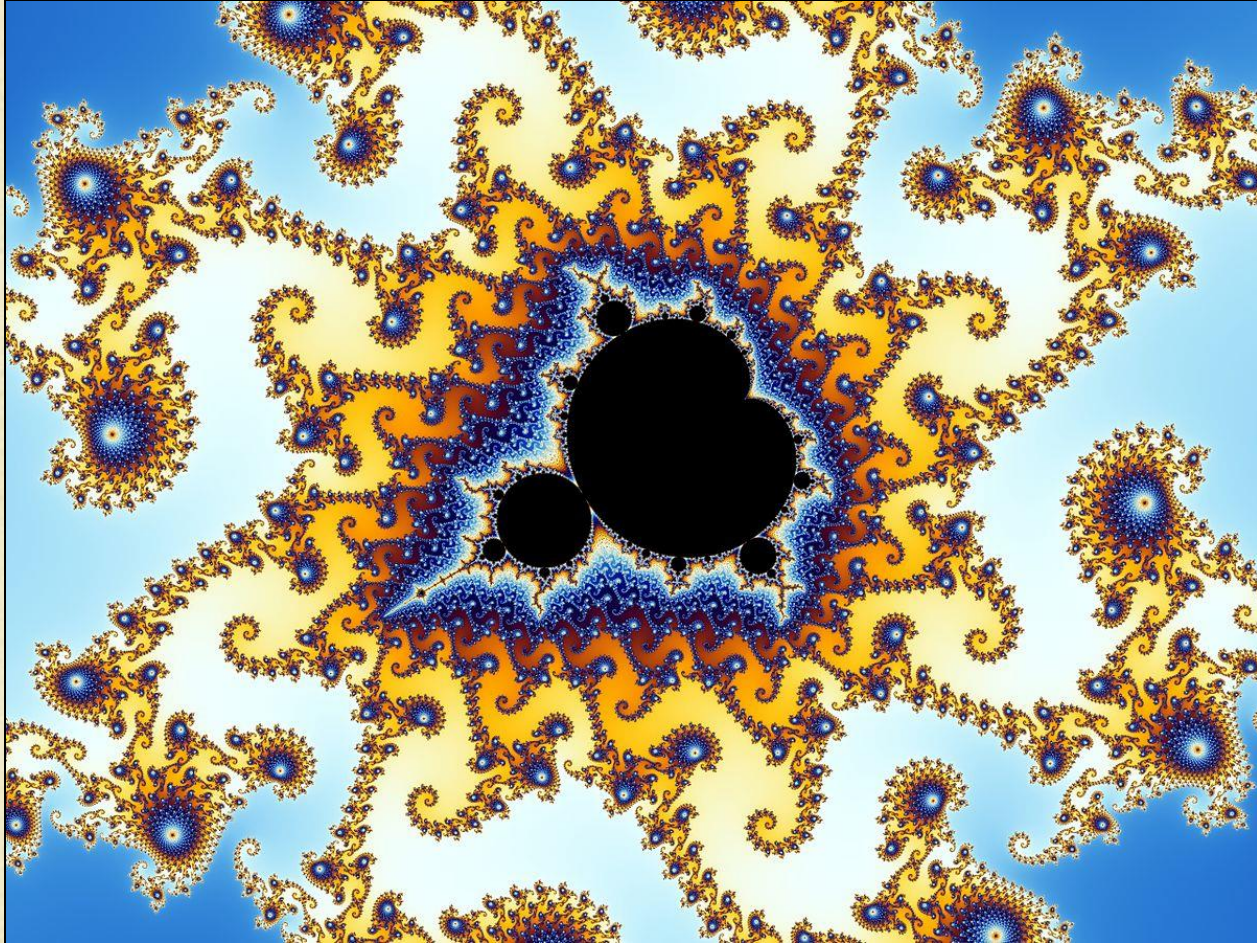
\$15
24 AUGUST 2018
sciencemag.org

AAAS

GRAPHENE QUASICRYSTALS

Twisted bilayer shows intriguing electronic properties *p. 782*

Fractals



Source: Mandelbrot-Wikipedia

The Mathematical Mind Finds Patterns in Everything



Aloe Plant Polyphylla Spiral, Wikimedia

Educational Materials

- Code.org
 - Protein Symmetry
 - Scratch Programming
 - Khan Academy
 - National Geographic Citizen Science
 - NASA Education
-