SEEING the FUTURE!
A Guide to Visual Communication

presented by
HOWTOONS and the Lemelson-MIT InvenTeams
In my head I hold the answer to a cleaner future!

I'm going to revolutionize the way we travel!

From this moment forward gravity will be my friend, not my enemy. Everywhere I go, I'll go by zip line!

It'll be an interconnected network of catenary lines.

I'll phase out the big ol' stinking school bus of yesterday!
We can utilize existing infrastructure and leverage the third dimension of the city...

Pulleys and Kevlar cables with shackles and...

Street poles with elevators...

and routing networks...

For people in the city...

Low friction high tensile strength...

Maybe some electric motor assist...

Total energy required will only be $E=mgh$, but then we need to compensate for friction and air resistance.

It will be great!

So Celine, can you imagine it? Do you see it?

I didn’t understand a word you just said. You really need to organize those thoughts, and if you really want me to see it...

I think that a drawing is the best way to share your invention.

That’s it. I’ll draw an image so inspirational it will communicate the promise and potential of this great idea.

But there’s only one problem...

I can’t draw.
Tuck...
You might not realize it yet, but everyone can draw!

Since the dawn of man we have used pictures, drawings, symbols, and doodles to communicate and share ideas.

In the Stone Age, cavemen painted nearly 2,000 images on a cave wall in Lascaux, France. These paintings depicted humans, animals, and symbols... What were they trying to tell us?

In 500 BC the Greeks shared their ideas through art. From sculpture, to murals on the walls to portraits on wood, the Greeks passed on their history and recorded their culture.

Inspired by the Greeks, the Italian Renaissance saw great progress in the visual arts. New technologies gave people the tools to communicate advancing ideas.
Nobody defined Renaissance Man better than Leonardo da Vinci. Inventor, artist, engineer, architect, and scientist, he did it all.

Although we cherish his fine art, it is through his notebooks that we get inspired by his genius. He shows a future imagined before its time: flying machines, solar and hydrodynamic energy, ideas on optics, weaponry, studies of botany and anatomy.

Since the Renaissance the intersection of art, science, and invention has continued to merge and propel us forward.

Whether it be artists, engineers, scientists, inventors, or designers, all great achievements start with a humble doodle.
Just put pencil to paper and BEGIN!

Can you...

...draw horizontal lines? Keep' em straight and parallel to the ground plane.

Try angled lines.

Now curves, like rainbows!

These lines can work together in a variety of ways. By training your artist's eye we can draw them to communicate, like the shapes below.

Horizontal

Vertical

make squares and rectangles

Vertical

Horizontal

make triangles

Angles

Angles

Curves

Curves

make ellipses and circles

It's all about learning the basics.

It's easy to draw once you learn to break down the shapes.
“Now you try! Start by drawing **lines** and **curves**. Then put them together to make **shapes** like squares, rectangles, triangles, and circles of all sizes. **Don’t** make mindless scribbles. Make marks with a **purpose**. All real inventors use graph paper. The guide lines are great for helping you write those equations neatly so they’re easy to follow and capture the scale of things. Practice how straight you can draw those lines. How smooth can you draw those curves? Have **fun** and get **loose**!”
But how does this help me draw my invention?

Using just a line you can describe recognizable shapes.

Look around you Tuck. These shapes are in everything we see.

Can you see it? You have to really look.

Okay.

The window frame is a rectangle.
The picture is an oval.
And the vase is an upside down triangle!

Now that I'm looking, I'm starting to see that I have the tools to draw anything!

Buildings

Cars

Rockets

People

Bikes

Rockets

Planets

My drawings are only limited to my imagination!

I'm ready to draw my zip line.

Voilà It's done!
“Now you’re just getting started. What’s your big idea for an invention? Draw it! Break down the shapes of what you see in your head and visually record it on the paper with your pencil.”
If we want our drawing to communicate we have to think and really look. Remember the cave paintings in Lascaux? That caveman artist painted over 600 different species.

Using just a simple line, he was able to accurately describe all of the different species. There’s no mistaking his bison for a horse. That caveman artist was good!

Look at the world around you. Let your pencil describe what you see!

In order to prevent your houses from looking like mushrooms we should look outside and reference a house instead of making it up inside of our heads.
We can improve our drawing by looking at how lines and shapes relate to one another!

It's called proportion.

See the spatial relationships and record it on paper.

Always ask yourself questions when you draw.

Is the house taller than it is wide?

Where does the tree line fall on the house?

Height

Width

Use vertical and horizontal markers to measure and build from.

What are the angles on the roof in relation to the horizontal window sill?

Find the shapes. Do you see the triangle on top of the square, sitting on the rectangular base?

How much higher is the roof than the telephone pole?

Draw it, and keep refining it until it looks right.

Why make it up if you don’t have to.

Great art and design are not arbitrary.

Use photos, toys, the internet, etc. to draw from.

Think and observe!

Trust your artistic instincts, but always question them.

Every mark should have a purpose!
“It’s your turn to **draw from life!** Look around you and try, as **accurately** as possible, to draw what you see. **Don’t** make anything up for this one. **Copy and reference** anything at your disposal. Look at books, pictures on the internet, and most **importantly** look at the **world** around you. Ask yourself, why you’re making each mark, what purpose does it serve?"
Drawing from observation has greatly improved my skill!

This is my best drawing ever!

Now that you're drawing proportionally let's draw up some thumbnails!

What do you think of the thumbnails?

I like this one. It is clearly communicating a person on a zip line going from their home to the school.

Now we can use this thumbnail to help guide our finished drawing.

Choose your paper size and blow up the drawing to fit!

"Use borders to frame your picture. The frame contains the idea and invites the viewer in!"

Thumbnails are small sketches that help plan the finished design.

They are great for testing out ideas and concepts.

Thumbnails are also ideal for figuring out the composition and what is best for communicating your idea or story.
This is it Celine. It’s pretty much exactly how I imagined.

It’s awesome Tuck! Is that you on the zip line?

“GRAVITY FUELED ZIP LINE” by TUCKER

It’s so cool how did you get up there?

Are there more options than hanging?

Yeah I guess it’s not for everyone.

Speaking of safety, we’ll need a stopping mechanism.

It’s a really inspiring picture, Tuck. Gravity may be a real solution for cleaner travel.

Good question. I didn’t think of that.

Let’s try... A staircase?

Are you sure it’s safe?

A spiral staircase will be a more efficient use of space.

“I’ll add a safety harness!”

“And we can turn the cab of the bus into a transporter.”

“And a crash pad with guard rails.”

Hmm, that takes up a lot of land.
“Alright, now it’s time for you to really think about and plan out that big idea. Using your pencil, generate some thumbnails in the smaller frames. Think about the different options for working out your idea. Remember thumbnails are loose concept sketches, don’t get carried away with detail. Choose the best thumbnails, refining and thinking to make the finished fully realized drawing of your invention below!”
Thanks for the brainstorm, Celine!

You’ve drawn and communicated your invention perfectly!

This drawing just isn’t as cool as I dreamt it.

This drawing communicated my idea, but it’s flat like the cavemen painting.
Hmmm... I think your drawing needs...

That extra DIMENSION!

That will give you A FRESH...

Giving your drawings the illusion of SOLIDITY, DEPTH, AND DISTANCE!
How do I do it?
First you have to see this blank sheet of paper as a window.
This sheet of paper is no different than...
A T.V.
Like paper, it is just a flat 2-D surface.

"Like T.V. we want to invite the viewer into the paper! We do that by drawing an illusion of space."

CELINE!

Come on in TUCK!
Celine, where are you?

Did you really just put your head through that paper?

And you know that drawing was just an illusion?

Please don't ever try that with the T.V.

Yes.

I do now.

Okay.

This drawing only describes two dimensions: height and length.

Now re-imagine the drawing with three dimensions: height, length and depth!

So depth is that extra dimension that invites us into a 2-D surface.
"Depth is crucial in creating the illusion of believable space on paper."

"And artists use perspective to draw that believable space."

"Hold your thumbs up at eye level. From my viewpoint your thumbs are the same size. There is no depth! Your thumbs are parallel to the picture plane. We can illustrate that by drawing parallel lines above and below your hands."

"If we change the viewpoint to your perspective, the closer thumb is twice the size of the distant thumb. From your viewpoint there is depth! The parallel lines framing your hands now converge at a vanishing point on the horizon line creating the illusion of distance."

"So what exactly is perspective?" "Perspective is a tool artists use to accurately draw objects as they appear in space."

"How do I see it?"
Let’s give your drawing some dimension.

Start by giving each object depth.

“First, establish a horizon line. The horizon line is the most important line in perspective. The horizon line is always at the artist's eye level. It is where the sky meets earth.”

“By placing a vanishing point on the horizon line we can draw objects in space correctly and relative to the viewpoint. In this case there is one vanishing point, making it a one-point perspective drawing.”

Vanishing points always fall on the horizon line.

“All things get smaller the farther they get from us. The goal is to create realistic depth and distance.”

“SKY

HORIZON LINE

EARTH

VANISHING POINT”
"We can change the angle of the view by adding vanishing points. Two is usually all we need."

**ONE-POINT PERSPECTIVE**

Look at how dramatic the effect is when we move the horizon line (the artist's view point). Like a movie director, you choose the shot that is best for your drawing.

**TWO-POINT PERSPECTIVE**

Give me a drawing from your eye level standing on the ground.

**THREE-POINT PERSPECTIVE**

Now from a bird's eye view.

How about a worm's eye view?

Like art, video games also progressed from flat... to games with one-point perspective... to games with two-point perspective... to fully immersive 3-D worlds.
Are you ready to put your drawings into one-point perspective? Perspective drawing is one of the harder skills to master. Follow the steps below to get started. Trace the gray lines as guides for your first try.

1. Draw a horizon line. This creates the viewer’s eye level.
2. Establish a vanishing point.
3. Draw various squares. From the corners of those squares draw lines back to the vanishing point.
4. Finish forms and erase interior lines that normally would not be seen.

“All objects can be broken down into simple geometric shapes: spheres, cubes, cones, cylinders, or a combination thereof. If you remember this rule and keep in mind how they relate to the horizon line (perspective) you will be able to draw anything.”

The most important thing an artist can do is practice. The more you draw with careful observation and attention to these principles the better your drawings will be.
Finally, I'm done. My vision is realized.

Tuck...

This is an incredible idea!

It will revolutionize the way we travel! We can...

Go global!

Make it modular for scale-up

Write special scenarios.

What do you think of my ideas?

I think that you should draw them!

The End!
**HOWTOONS.COM** A series of comics that teaches kids how to build things using everyday household objects. Combining storytelling with instructions, the Howtoons universe is built of material that inspires dreaming, invention, creativity, and hands-on adventure. Howtoons has a foundation of science and engineering education, sparking creativity through art and imagination. We hope to inspire the future thinkers of tomorrow to not accept the world for what it is, but instead create a world that they would like it to be.

Visit the Howtoons website and enjoy all the free downloadable content at [http://www.howtoons.com/](http://www.howtoons.com/)

Contact at info@howtoons.com

---

**Lemelson-MIT**

**InvenTeams** The InvenTeam initiative, created by the Lemelson-MIT Program, offers an unparalleled opportunity for high school students to cultivate their creativity and experience invention. InvenTeam students rely on inquiry and hands-on problem solving as they apply concepts from science, technology, engineering, and math (STEM) to develop invention prototypes. After the InvenTeam experience, inventive cultures often continue to prosper at participating schools through further development of InvenTeam prototypes or pursuit of new invention projects.

Visit the InvenTeams website to see what high school students are inventing at: [http://web.mit.edu/inventeams/](http://web.mit.edu/inventeams/)

Contact at inventeams@mit.edu