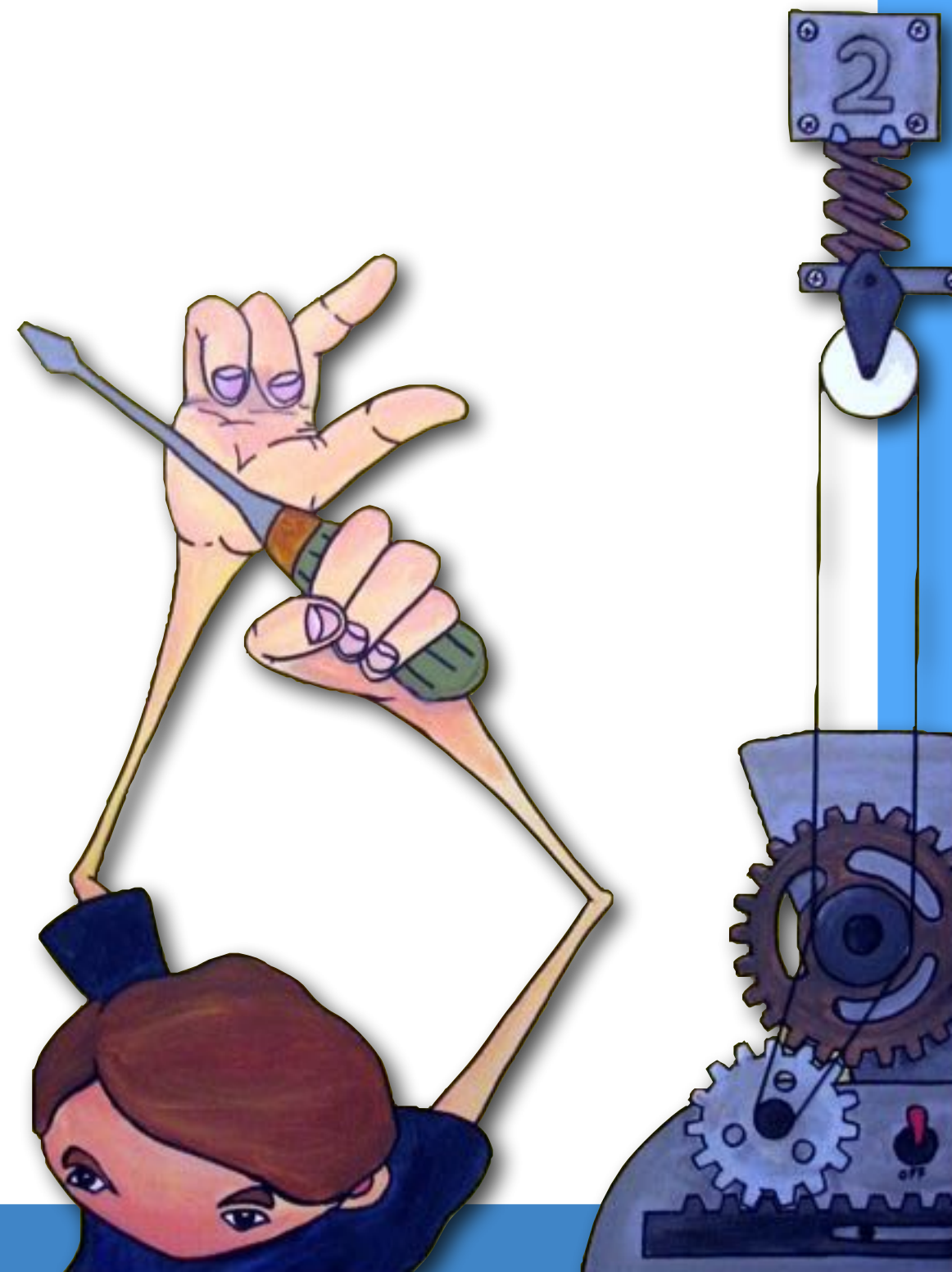


Basics of Mechanical Engineering Design



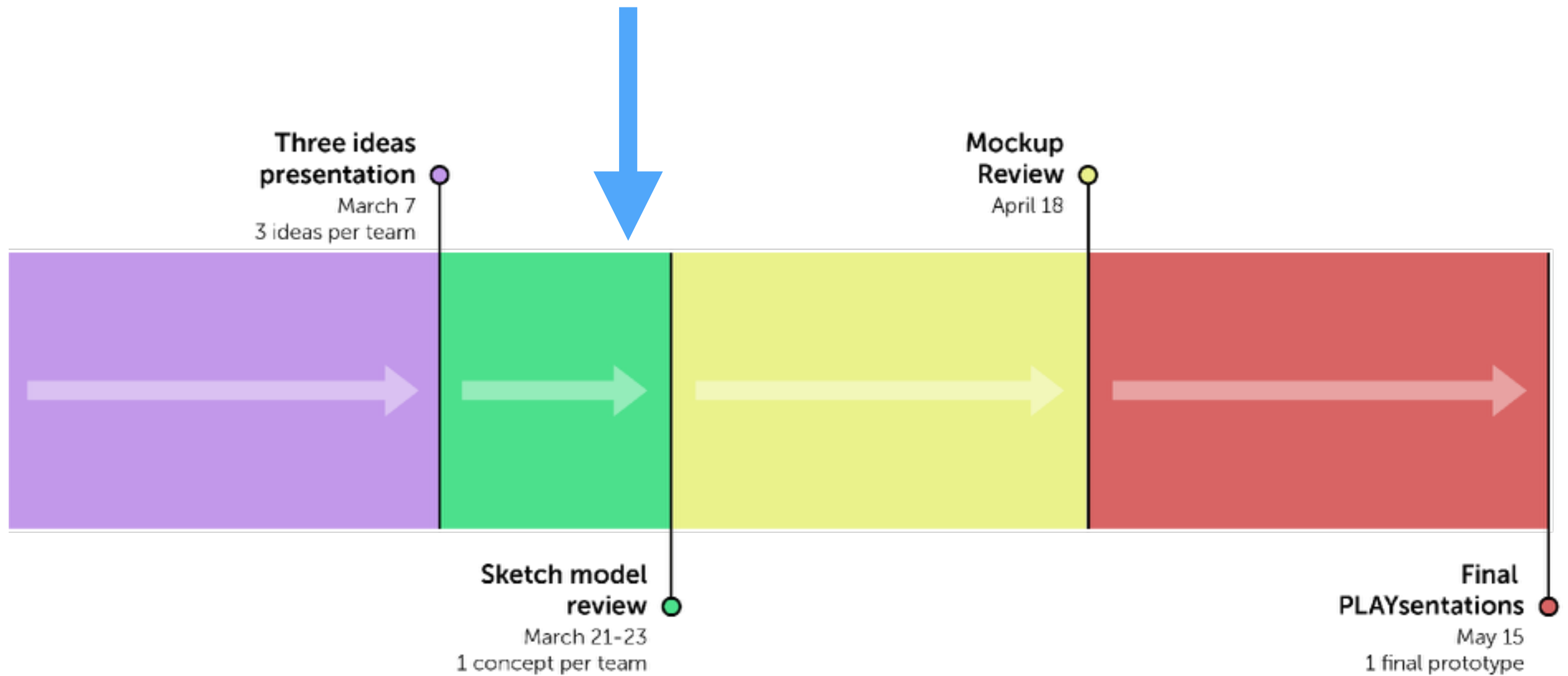


Playtesting!

Something your
team learned...



Semester workflow



Sketch Model Design Critique!

All 4 sketch models to be reviewed in lab!

In lab this week: 1 hour of prep,
1 hour of reviews
(15 minutes each review)

Additional PDL hours
on the website



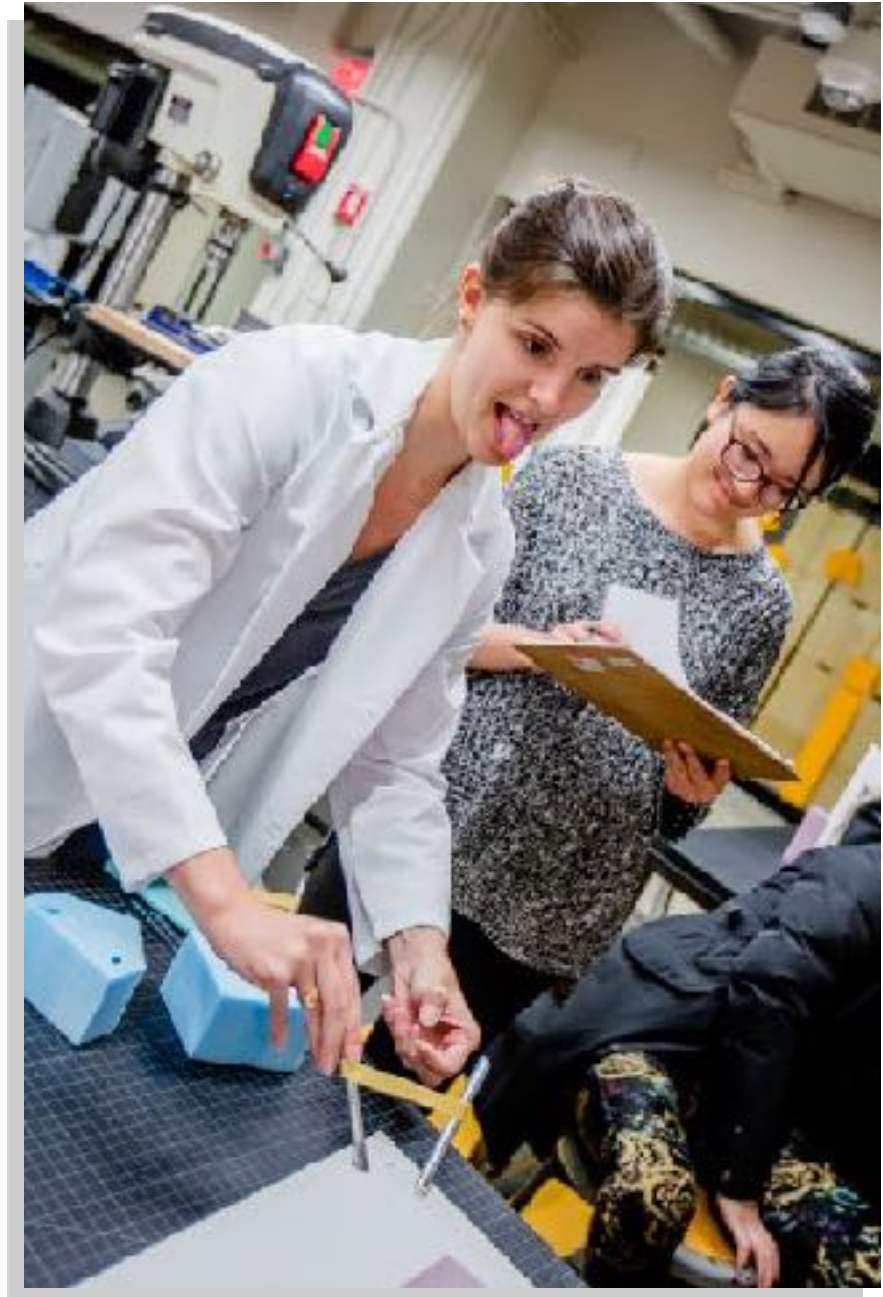
Sketch Model Design Critique!

What is the concept?

What is the question you're trying to address with your sketch model?

How does your model answer those questions?

What did you learn in playtesting?



Design Critique!

More show, less tell



Design Critique!

More ~~show~~, less tell
play!



Using the Review to your Advantage

Informal, but prepare!

Revise your sketch model based on the BCM playtesting

Short introductions (but quick)

Have a plan. If reviewers don't have questions, prompt your own

It's **OK** to not know!



Questions?



Sketch Model

Design Critique!

To the PDL! (and beyond)

PDL today:

Camel
Crocodile
Goose
Hedgehog
Hippo
Koala
Llama
Lobster

Lecture today:

Meerkat
Moose
Narwhal
Ostrich
Tiger
Panda
Squid
T-Rex

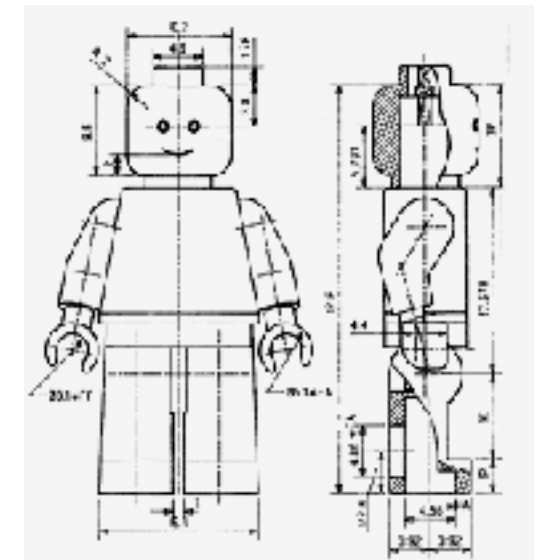


Meet in (3-370) on Wednesday!

Estimation!
is a super important thing!



Estimation

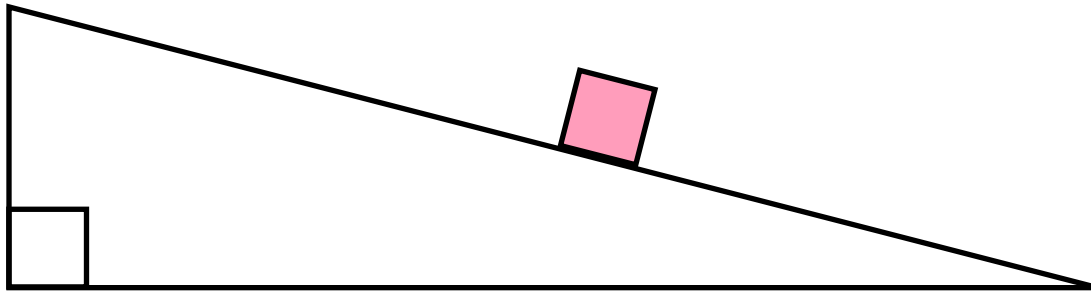


Estimation in Toy Design!

100W!



Estimating Julie's Output



$$\begin{aligned}\theta &= 5^\circ \\ m_{\text{Julie}} &= 20\text{kg} \\ v_{\text{Julie}} &= 1\text{ m/s}\end{aligned}$$

A diagram of a pink square block with two force vectors. One vector, labeled F_{downhill} , points parallel to the incline. The other vector, labeled F_g , points vertically downwards.
$$F_{\text{downhill}} = m_{\text{Julie}} * g * \sin\theta$$
$$F_g = m_{\text{Julie}} * g$$

$$P_{\text{Julie,uphill}} = F_{\text{downhill}} * v_{\text{Julie}}$$

$$P_{\text{Julie,uphill}} \approx 17\text{ W}$$

Way less
than 100W!



What else is 100W?

$$\text{Energy} = mgh = m * 10 \frac{m}{s^2} * 0.5m$$

$$\text{Energy} = \text{power} * \Delta \text{time} = 100W * 1s$$

$$m = 20\text{kg!}$$



Team Estimation Game

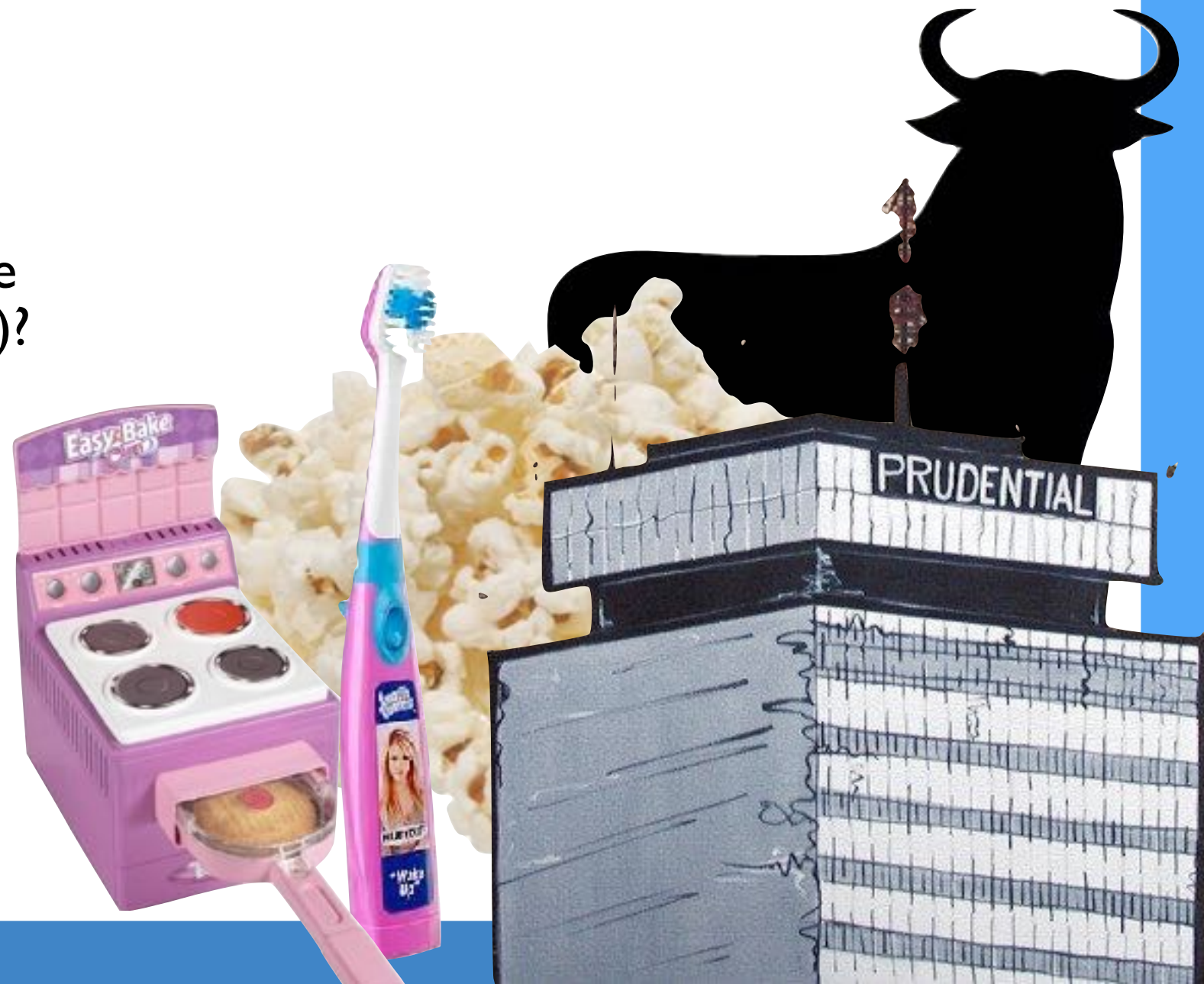
How many Prudential Centers
fit lying down across the
Harvard Bridge?

What is the cost per popcorn
kernel at the movie theatre?

How much energy does it take
to brush your teeth (manually)?

Can you power a mechanical
bull in your house on a
standard wall outlet?

How long will it take to
heat a hot dog with an
Easy Bake Oven?



Team Estimation Game

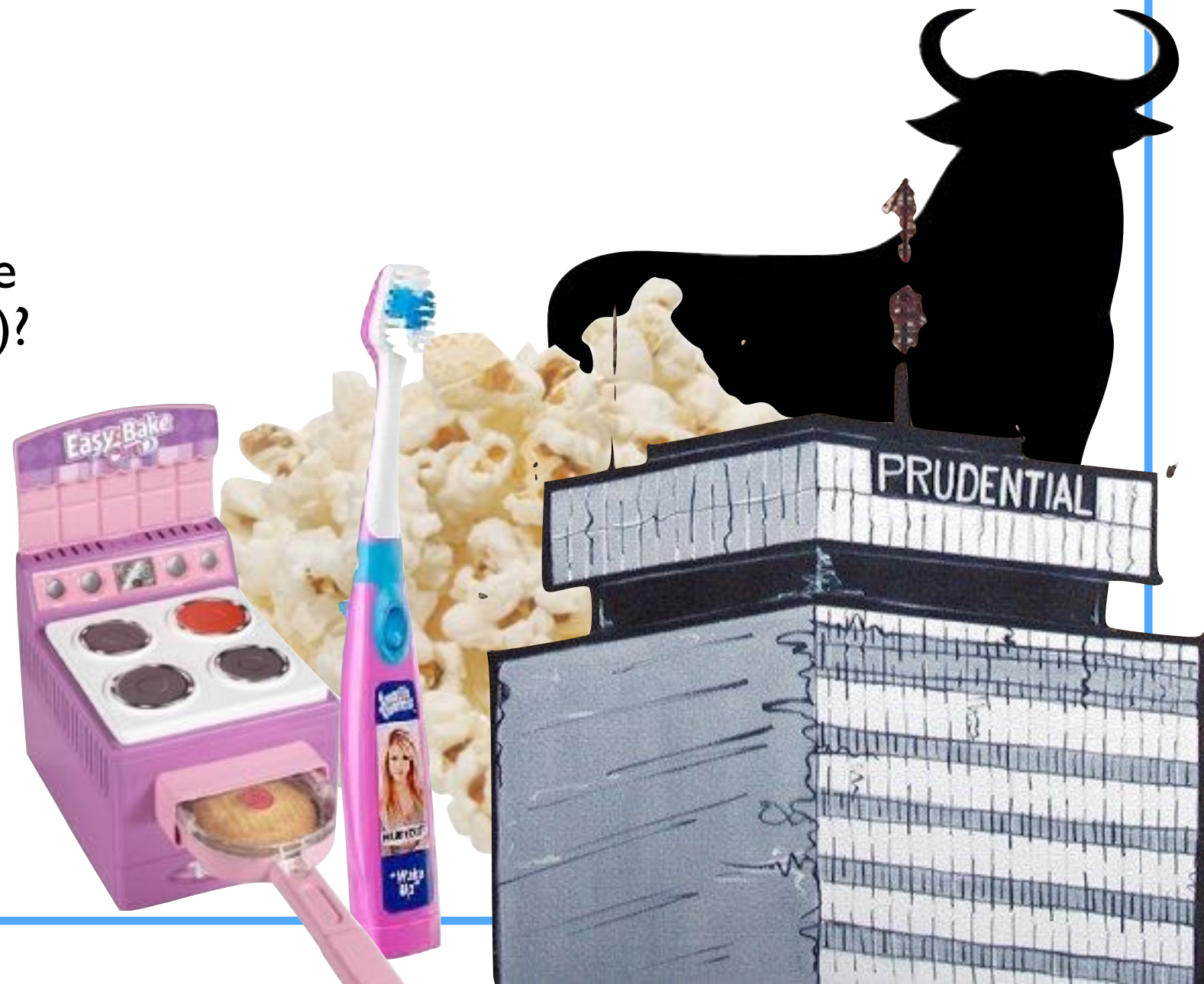
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How much energy does it take to brush your teeth (manually)?

Can you power a mechanical bull in your house on a standard wall outlet?

How long will it take to heat a hot dog with an Easy Bake Oven?





Engineering Design Terminology

Popular Mistakes Game!

nut vs. washer



th a hole used for
sometimes spacing

Popular Mistakes Game!

nut vs. washer
tap vs. die



a

ole

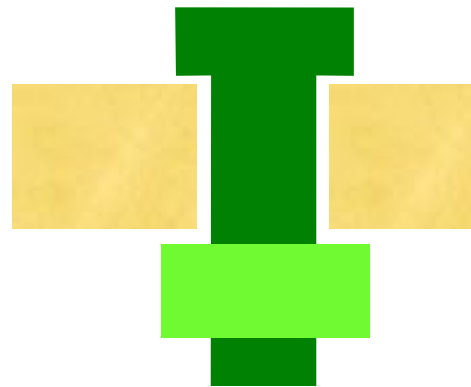


a **die** is a tool

on a shaft

Popular Mistakes Game!

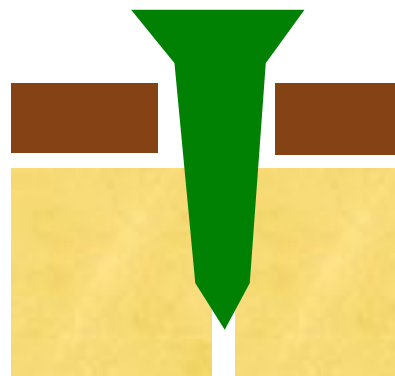
nut vs. washer
tap vs. die
bolt vs. screw



requires a
through hole
or a tapped
hole



bolts are externally threaded fasteners designed for insertion through holes tightened with a nut



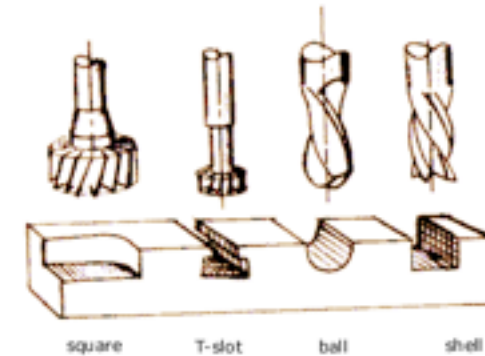
requires a
pilot hole



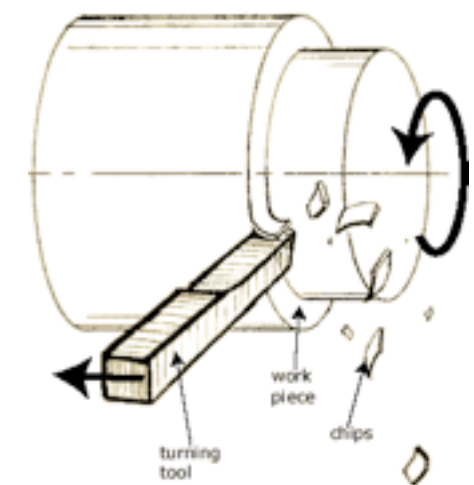
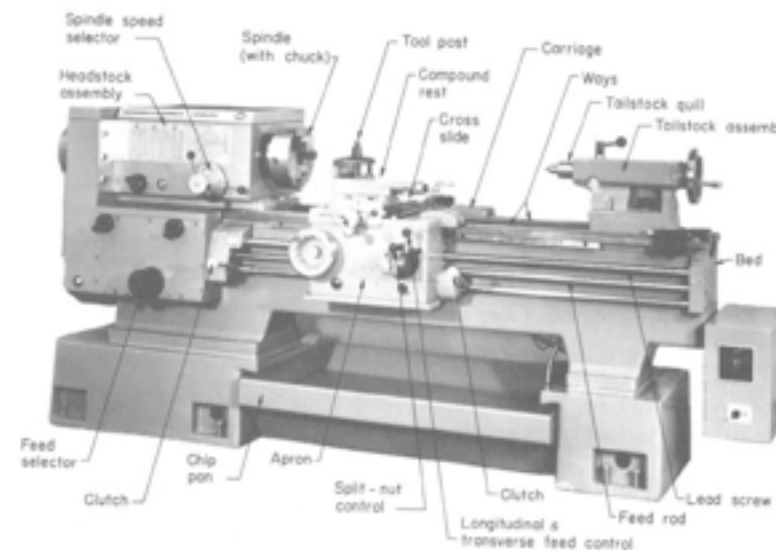
screws are shafts, typically tapered, with a helical groove or thread formed on its surface

Popular Mistakes Game!

nut vs. washer
tap vs. die
bolt vs. screw
milling vs. turning



milling is like drilling but
can cut in the sideways
directions too



turning is machining cylindrical parts on a lathe

Popular Mistakes Game!

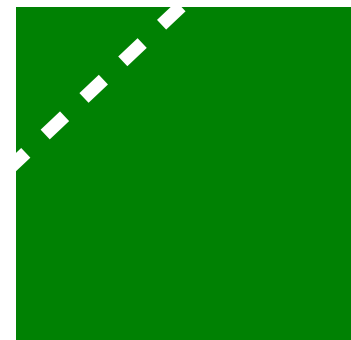
nut vs. washer

tap vs. die

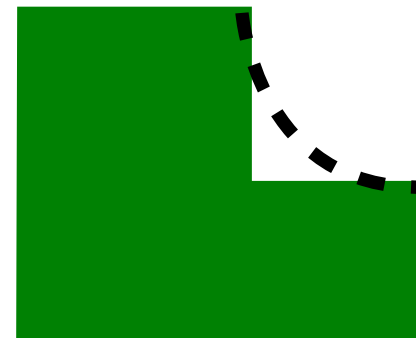
bolt vs. screw

milling vs. turning

chamfer vs. fillet vs. round



chamfer is a beveled edge connecting two surfaces



fillet is the rounding of an interior edge



round is the rounding of an exterior edge

Popular Mistakes Game!

nut vs. washer

tap vs. die

bolt vs. screw

milling vs. turning

chamfer vs. fillet vs. round

bevel vs. bezel



a **bevel** is a face detail of a product



a **bezel** is also an engraved, flattened side of a ring



a **bezel** is a groove holding the cover of a product in position

Popular Mistakes Game!

nut vs. washer

tap vs. die

bolt vs. screw

milling vs. turning

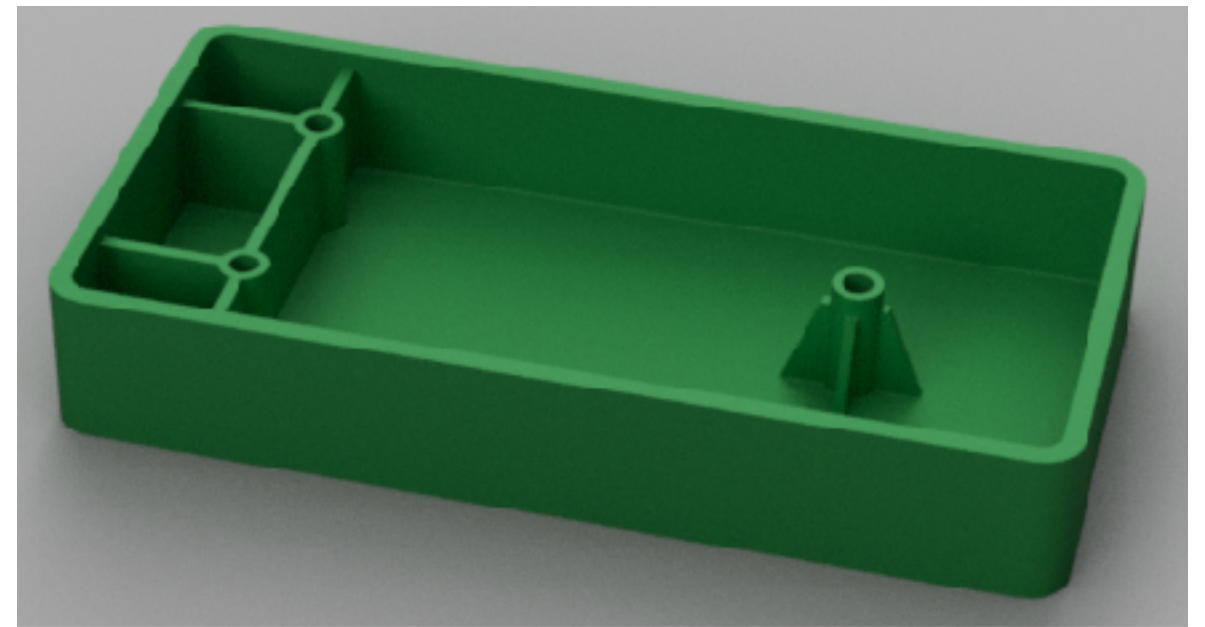
chamfer vs. fillet vs. round

bevel vs. bezel

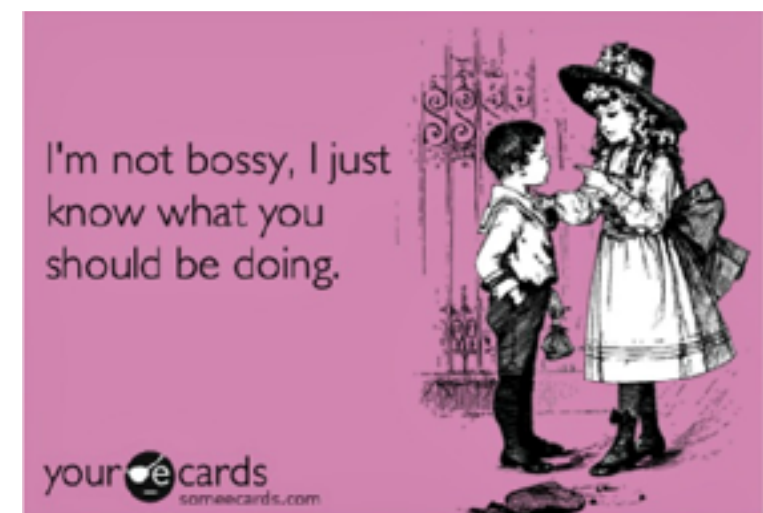
boss vs. boss vs. boss



boss means supercool, fly, or awesome to the max



boss is a protruding feature on a work piece



boss is a not fun teammate

Popular Mistakes Game!

nut vs. washer

tap vs. die

bolt vs. screw

milling vs. turning

chamfer vs. fillet vs. round

bevel vs. bezel

boss vs. boss vs. boss

flange vs. collar



a **flange** is a protruding rim of an object



a **collar** is an added rim around an object

Popular Mistakes Game!

nut vs. washer

tap vs. die

bolt vs. screw

milling vs. turning

chamfer vs. fillet vs. round

bevel vs. bezel

boss vs. boss vs. boss

flange vs. collar

standoff vs. standoff



a **standoff** is used to raise
PCBs off of a surface

Also a standoff...

Popular Mistakes Game!

nut vs. washer

tap vs. die

bolt vs. screw

milling vs. turning

chamfer vs. fillet vs. round

bevel vs. bezel

boss vs. boss vs. boss

flange vs. collar

standoff vs. standoff



a **standoff** is used to raise
PCBs off of a surface

Popular Mistakes Game!

nut vs. washer
tap vs. die
bolt vs. screw
milling vs. turning
chamfer vs. fillet vs. round
bevel vs. bezel
boss vs. boss vs. boss
flange vs. collar
standoff vs. standoff
parting line vs. parting line



a **parting line** is where
two halves of a mold meet

a **parting line** is a line whose main action is to part

Popular Mistakes Game!

nut vs. washer

tap vs. die

bolt vs. screw

milling vs. turning

chamfer vs. fillet vs. round

bevel vs. bezel

boss vs. boss vs. boss

flange vs. collar

standoff vs. standoff

parting line vs. parting line

inexpensive vs. cheap



inexpensive means relatively
low cost for the product



cheap includes a low quality connotation

Popular Mistakes Game!

nut vs. washer

tap vs. die

bolt vs. screw

milling vs. turning

chamfer vs. fillet vs. round

bevel vs. bezel

boss vs. boss vs. boss

flange vs. collar

standoff vs. standoff

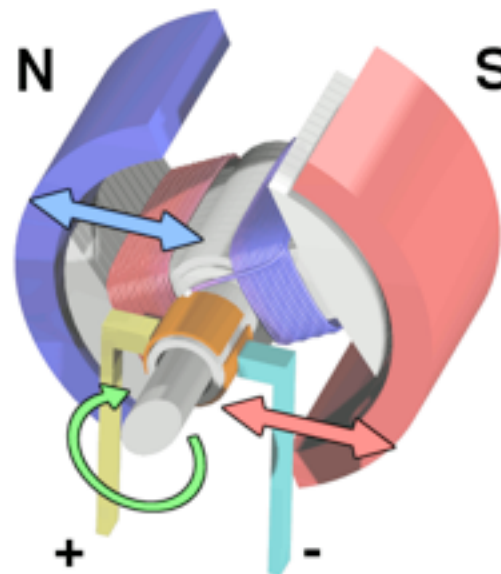
parting line vs. parting line

inexpensive vs. cheap

engine vs. motor



engines produce kinetic energy from a fuel source



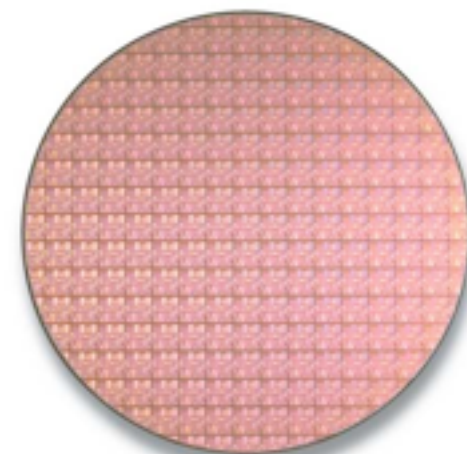
electric **motors** convert electricity into mechanical motion

Popular Mistakes Game!

nut vs. washer
tap vs. die
bolt vs. screw
milling vs. turning
chamfer vs. fillet vs. round
bevel vs. bezel
boss vs. boss vs. boss
flange vs. collar
standoff vs. standoff
parting line vs. parting line
inexpensive vs. cheap
engine vs. motor
silicone vs. silicon



silicone is a manmade rubber-like polymer



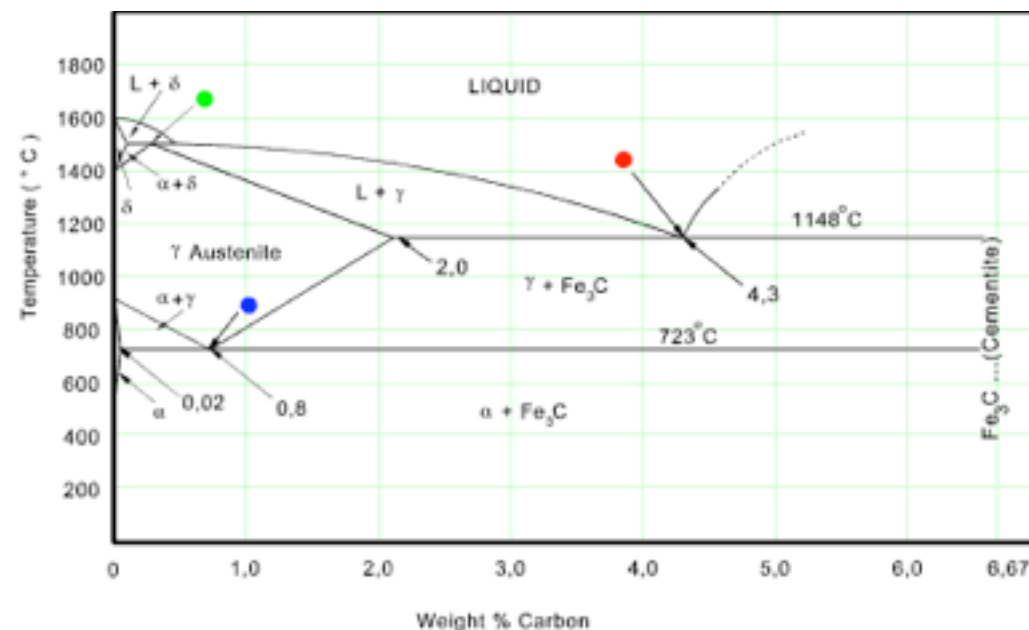
silicon is an element that makes up sand and is used to make semiconductor wafers

Popular Mistakes Game!

nut vs. washer
 tap vs. die
 bolt vs. screw
 milling vs. turning
 chamfer vs. fillet vs. round
 bevel vs. bezel
 boss vs. boss vs. boss
 flange vs. collar
 standoff vs. standoff
 parting line vs. parting line
 inexpensive vs. cheap
 engine vs. motor
 silicone vs. silicon
 metal vs. steel

Alkali Metals										Noble Gases									
Alkaline Earth										Nonmetals/Metaloids									
Transition Metals										Halogens									
H											He								
Li	Be											B	C	N	O	F	Ne		
Na	Mg											Al	Si	P	S	Cl	Ar		
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe		
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn		
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub								
Lanthanides		Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu				
Actinides		Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr				

there are many **metals** which are basic elements



steel is a metal alloy of iron and carbon

Popular Mistakes Game!

nut vs. washer

tap vs. die

bolt vs. screw

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chamfer vs. fillet vs. round

bevel vs. bezel

boss vs. boss vs. boss

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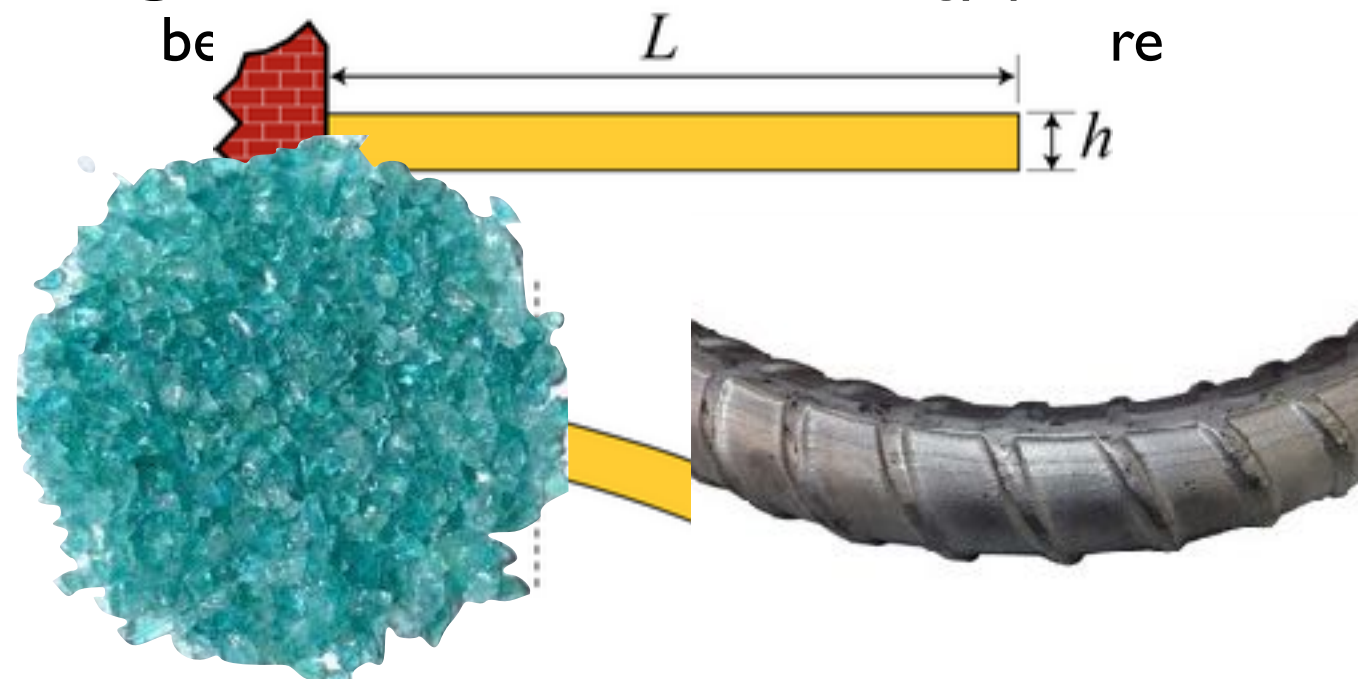
metal vs. steel

stiff vs. strong vs. tough **vs. swole**

stiffness how a material deforms when loaded

strength refers to materials ability to withstand load without failure

toughness is the amount of energy per volume



Toy-Pardy!

Vote on Blade boxes

