Einstein's Birthday and Pi Day!!

It's all relative.

Test hand-back and walkthrough.

- Areas of concern: Not many, many A's but a few struggling.

Albert Einstein Research

- Who was this man? Why does everyone always say Einstein was this genius? What did he do that was so great? What ideas in science did he contribute?

Relativity

It's all relative!!

RELATIVITY: 19th CENTURY MYSTERIES

- Mercury's orbit
- Radioactivity (discovered in 1892)
- Sun's energy-producing mechanism
- EM waves in a vacuum
- Small scale (atomic) phenomena, such as discrete spectra from gases and photoelectric effect
- Relative motion applied to light

RELATIVITY: LIGHT

- EM wave
- Can travel through a vacuum (no ether)
- Speed $c = 3 \times 10^8$ m/s in vacuum
- Behaves as wave <u>and</u> particle (photon)
- $E = mc^2$
- Einstein's 2 fundamental postulates about light:
  - $c = 3 \times 10^8$ m/s regardless of observer's motion
  - Laws of physics are same in all frames of reference moving in uniform motion (i.e., no acceleration)

RELATIVITY: THE CONFLICT

V

A: MOVING

C

LIGHT SOURCE

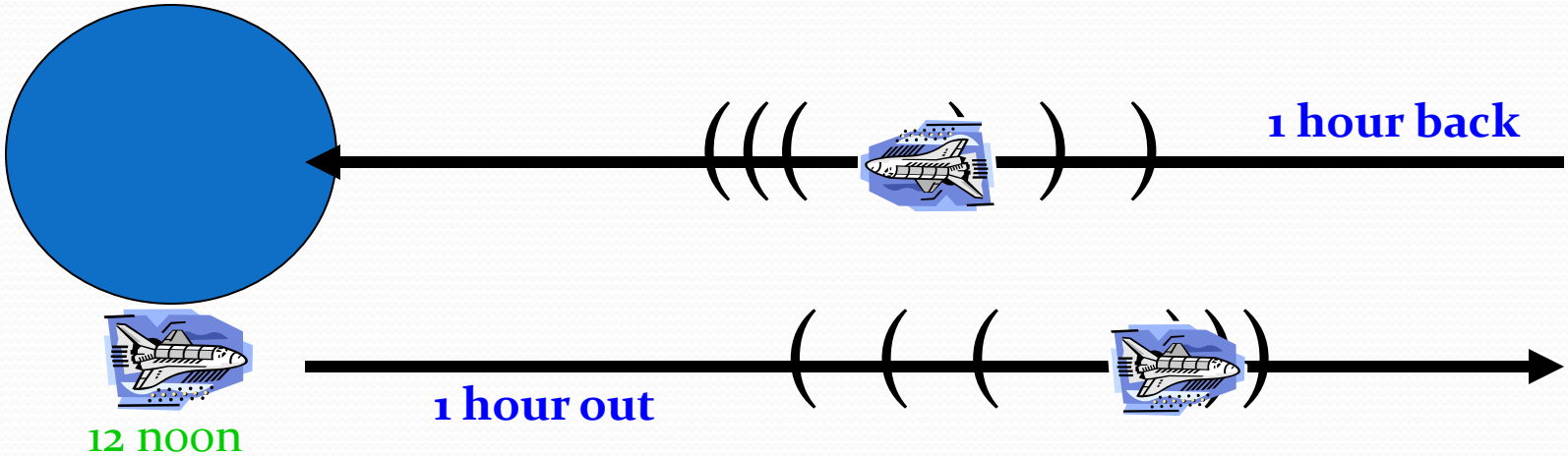
B: STANDING STILL

CLASSICAL		RELATIVISTIC
A measures C + V	⟺	Both measure C
B measures C	*HOW CAN THIS BE???*	

Who Plans on Going to College?

Who Plans on being a Physics Major?

RELATIVITY: HOW IT WORKS (Doppler!)



- Spaceship travels at 60% speed of light.
- Spaceship emits light pulse every 6 minutes.
- Earth receives light pulses every 12 minutes out, 3 minutes in.
- Classical physics says Earth and spaceship times are same.
- Relativistic physics says:

	# pulses out	# pulses in	Δt	Time
SHIP:	10 6'	10 6'	120	2:00pm
EARTH:	10 12'	10 3'	150	2:30pm

RELATIVITY: TWIN PARADOX

- 1 twin stays behind on Earth.

- 1 twin travels at v = 0.6c to "new" planet 30 LY away.

EARTH TIME: $\Delta t = 30\ LY/0.6 = 50$ years x 2 (round trip)

= 100 years in the future

SPACESHIP TIME: $\Delta t' = \sqrt{\Delta t \quad 1-v^2/c^2} \quad = \sqrt{100 \quad 1-.36}$

= 80 years in the future

RELATIVITY: 3 EFFECTS

Speed of ship as percentage of light	*length of ship (metres)*	*Mass of ship (tons)*	*Duration of ship-hour in minutes (Earth = 60)*
0	100.00	100.00	60.00
10	99.50	100.50	59.52
20	97.98	102.10	58.70
30	95.39	104.83	57.20
40	91.65	109.11	55.00
50	86.60	115.47	52.10
60	80.00	125.00	48.00
70	71.41	140.03	42.75
80	60.00	166.67	36.00
90	43.59	229.42	26.18
95	31.22	320.26	18.71
99	14.11	708.88	8.53
99.9	4.47	2,236.63	2.78
99.997	0.71	14,142.20	1.17
100	zero	infinity	zero

RELATIVITY

MARCH 14

$E = mc^2$

Energy = morning

X

2 cups of hot chocolate

Too much Gravity

Black holes, Quasars, and Worm Holes

Einstein Revealed

- How gravity really works.

Black holes Youtube videos

- https://www.youtube.com/watch?feature=fvwp&NR=1&v=DbhuRcmSkMg
- https://www.youtube.com/watch?v=KHSZcSowpgg&feature=related
- https://www.youtube.com/watch?v=EgUxa9WfZcQ&feature=related
- https://www.youtube.com/watch?v=3pAnRKD4raY