



Sc.10 Astronomy

A PBL Unit



A Waste of Space?

<https://youtu.be/L5BdLVRg7Lo>

<https://youtu.be/zBkHUKKSHXo>

Scale of the universe

Arrange these pictures from:

Smallest to largest

Nearest to farthest

Youngest to oldest

Brightest to dimmest in the sky



Questions that you have about Space?

1. How are planets formed?
2. How do we survive Van Allen belts?
3. How likely is it for a planet to be destroyed?
4. Are people from other planets likely to be friendly?
5. What happens when you take off your helmet in space?
6. Once we establish a colony on Mars, how do we deal with citizenship, laws, society
7. How different would people become, after colonization?
8. Is there life already on other planets?

Questions that you have about Space?

1. Is it possible that there was once life on Mars?
2. Can we touch the Sun?
3. Which planets have water? In what state?
4. How did the Sun get so big?
5. How hot is the Sun? How does it vary?
6. How does the universe's size and temperature change?
7. How does Star Wars and other science fiction (Star Trek) compare to real science?
8. What do explosions look like in space?
9. What if we didn't have any stars?
10. How can we achieve light speed travel? What does light speed look like?

Questions that you have about Space?

1. Is there a planet in our solar system that can support complex life?
2. What are the different types of stars and what type of star is the Sun?
3. Astronuclear physics - energy involved in star burning
4. Light involvement with the universe
5. How is the hydrogen in the sun “just there”?
6. What happens near a black hole? What’s going on IN a black hole? Could a black hole lead to a worm hole?
7. What is anti-matter? What is dark matter?
8. How does the universe expand? What is it expanding to?
9. How much of the universe have we mapped?
10. What are the dimensions of the universe?

Questions that you have about Space?

1. How is a galaxy formed?
2. Why are planets round?
3. How do planets and stars generate gravity?
4. Why do they start spinning?
5. What happens when 2 black holes collide? Will this destroy the space-time continuum?
6. How are wormholes formed?
7. What is the center of the universe? Is there a center of the universe?
8. What are gravitational waves? How are they detected?
9. Can stars collide?
10. How do galaxies die? Do they die?

Questions that you have about Space?

1. If we've never been outside our solar system, how do we know what our galaxy looks like?
2. Can there be more than star in a solar system?
3. If planets are held by gravity, then how do they collide?
4. How much of astronomy is theorized?
5. What is gravity?
6. What's a nebula?
7. How do the sun and moon affect the tides?
8. Are the memes in space "dank"?
9. What matter is used in the creation of a galaxy?
10. What are Fermi bubbles?

Questions that you have about Space?

1. Why is space black?
2. Why is the earth rocky and Jupiter is a gas giant?
3. Does a planet need sun to support life?
4. Is the Andromeda galaxy headed for a clash with the Milky Way?
5. What is a quasar?
6. Are alternate dimensions a “thing”?
7. How do stars burn without oxygen?
8. What is the Mandela effect?
9. What will Osiris Rex discover at an asteroid bennu?
10. Why can't we see black holes?

Questions that you have about Space?

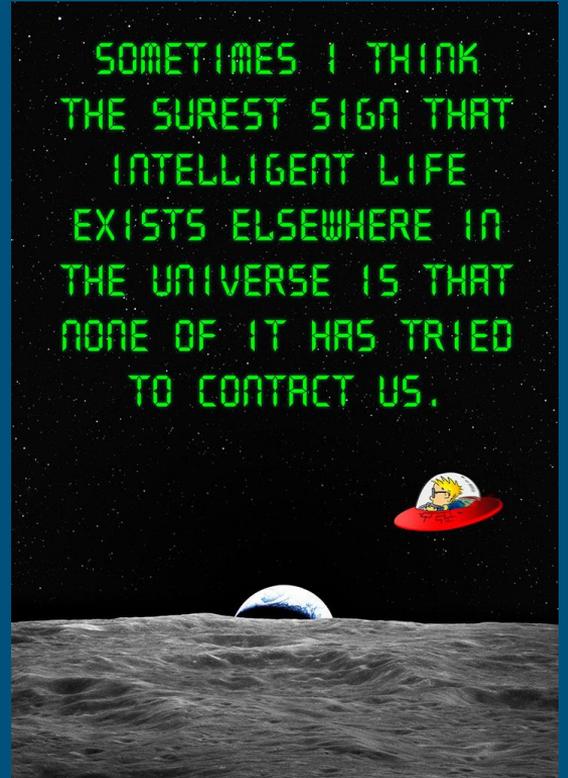
1. Can we travel at light speed?
2. How does time pass when we travel in space?
3. What defines a planet and why isn't Pluto a full planet?
4. What is the ripple effect?
5. If the moon was a piece of the earth that was knocked off, why is it a perfect sphere?
6. Is time travel possible?
7. How do we calculate speed of planets? Distances? Masses in space?
8. Why don't the rings/moons of Saturn crash into the planet?
9. How do we know what the sun is made of?
10. Why can't we always see planets from earth?

Questions that you have about Space?

1. What ignites supernova explosions?
2. Why don't large meteors get stuck in Earth's gravitational pull?
3. Do gas giants have a physical surface and can we "land" on them?
4. Can life be sustained on gas giants?
- 5.
- 6.

Driving Question

What are the **most important factors** to **consider** for complex **life** on **other worlds**?



How to use the Driving Question

Everything that we do in this unit, I want you to have the Driving Question in the back of your mind...

Learning Outcomes and Context

Here's what we are going to learn and why!

<https://goo.gl/NSkhhd>

What am I going to have to do?

See the list of things that you can choose to do...

<https://goo.gl/UB51ch>

Exit Ticket - 1

1. What chemical processes are necessary for life?
2. What do we mean when we say complex life?
3. How do life forms obtain and use energy?
4. What are other worlds? Give some examples
5. What are some properties that might make other worlds hostile to complex life?

What is the history of life on Earth?

History of everything?

What are you?

What is Earth?

Exit Ticket - 2

1. Where did life first develop on earth?
2. How long into Earth's history did it develop?
3. What was the earth like (climate, atmosphere, etc.) when life developed?
4. What type of life developed initially on Earth?
5. Should **we** be **looking** for **complex life** on **other worlds**? Why or why not?

Chromebooks

Start a Google doc or slide, share it with gsjokvist@gedu.sd73.bc.ca

Opening paragraph: why should we care about space exploration?

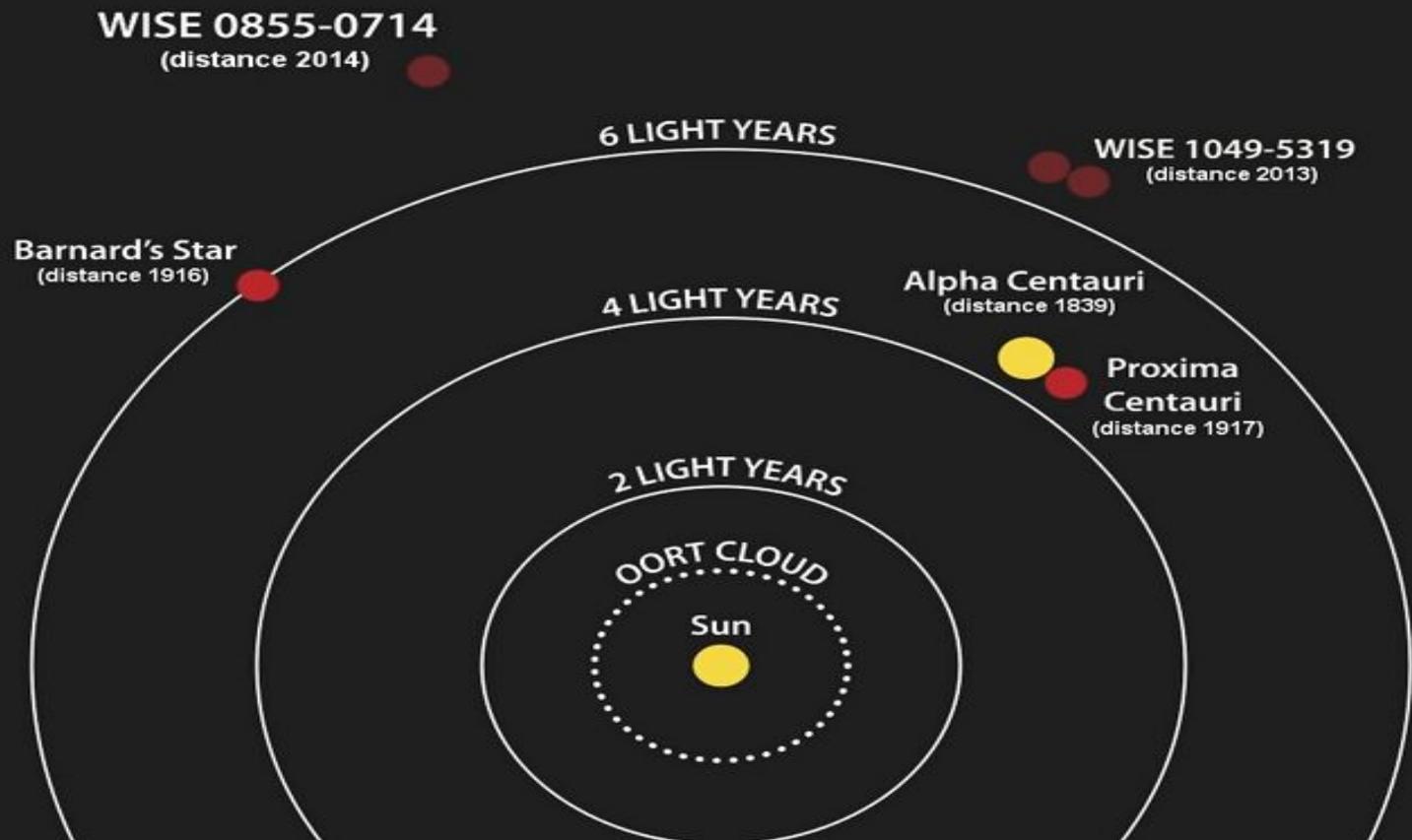
How big is the universe?

<https://www.youtube.com/watch?v=nxs5wye0JXs>

Exit Ticket - 3

1. How long will Rigel (a giant star) live compared to the sun?
2. Is it likely that we would find life on a planet orbiting Rigel, considering how long it took for life to form on Earth?
3. Is there liquid water on Venus? Mars? Why or why not for both? (Think of the story of **Goldilocks**)
4. How could you apply the “Goldilocks zone” to exoplanets (you may need to look this term up)?
5. What chemicals should we be looking for to support life? What type of life will be supported by each?

THE SUN'S CLOSEST NEIGHBORS



Exit Ticket - 4

1. What is gravity?
2. Take a piece of paper, squeeze it in all directions toward the center. What shape does it form? Tear out a small chunk and do it again. How does this apply to gravity and the formation of our moon?
3. Check out the gravitational field demonstration. What shape is the path of the object? What's your record?
4. How can we apply this to planets? To moons? To artificial satellites?
5. What happened to the gravitational pull when the object in the middle increased in mass? How would this apply to different star systems?

Will We Ever Reach Another Star?



https://www.youtube.com/watch?v=ID08CuUi_Ek

Exit Ticket - 5

1. How long does it take a spacecraft flying to the moon compared to a signal going to the moon?
2. How many light years to the nearest star?
3. How long would it take to fly there in a space ship 40x faster than the space shuttle? (0.1% of the speed of light)
4. Are we more likely to communicate indirectly with aliens first, or travel to another planet/world? Why?

Are other galaxies moving away from us?

— Graph the following data on a google sheet:

Galaxy	Distance /MPc	Velocity /km s ⁻¹
NGC 0055	2	94
NGC 0045	8	493
NGC 0063	18.7	1303
NGC 2271	29.3	2408
NGC 0514	34.4	2568
IC 0381	39.4	2629

Can we demonstrate this with the expanding space of a balloon?

1. Blow up a balloon to a few centimeters across (but don't tie it)
2. Draw the Milky Way (our galaxy), then 4 others labelled A through D
3. Measure the distance to each galaxy from the Milky Way
4. Blow up the balloon to a much larger size
5. Measure the new distance to each galaxy
6. Subtract the two distances and divide by time to estimate velocity

Ex: $13-5 = 8 \text{ cm}/4\text{s} = 2 \text{ cm/s}$

7. Graph the results on your Google sheet.

Exit Ticket - 6

1. How does the speed of a galaxy relate to its distance?
2. How did the speed of your balloon galaxies relate to distance?
3. How do the results of your experiment support the “inflating balloon” model of the universe? What part of this model do you disagree with?
4. Does a successful model mean that it truly represents reality?
5. What is the Big Bang Theory (not the TV show!)?
6. Create a timeline for the formation of the universe from the Big Bang to now.

STARGAZING LIVE THE UNIVERSE THROUGH TIME



UNOBSERVABLE UNIVERSE

THE BEGINNING

The Universe begins 13.7 billion years ago with an event known as the Big Bang. Both time and space are created in this event.

FRACTION OF A SECOND

Rapid expansion occurs during a fraction of a second - a billionth of a second - in the visible Universe is the size of a grapefruit.

1 SECOND

The Large Hadron Collider at CERN is recreating the conditions that prevailed a fraction of a second after the Big Bang.

100 - 1000 SECONDS

Nuclei of hydrogen, helium, lithium and other light elements form.

300,000 YEARS

Its own detectable radiation from the early formation of the Universe leaks out for the first time. Before this, the Universe is opaque. It's so hot it has been cooked over it.

POTENTIALLY OBSERVABLE UNIVERSE

A FEW HUNDRED MILLION YEARS

Matter clumps together under its own gravity forming the first protogalaxies and within them, the first stars.

Stars are nuclear furnaces in which heavier elements such as carbon, oxygen, silicon and iron are formed. Massive stars exploding as supernovae create even heavier elements. Such explosions send material into space ready to be incorporated into future generations of stars and planets.

A FEW BILLION YEARS

Initially, the expansion of the Universe decelerated - but a few billion years after the Big Bang, the expansion began to accelerate. The acceleration is caused by a mysterious force known as 'dark energy', the nature of which is completely unknown.

9 BILLION YEARS

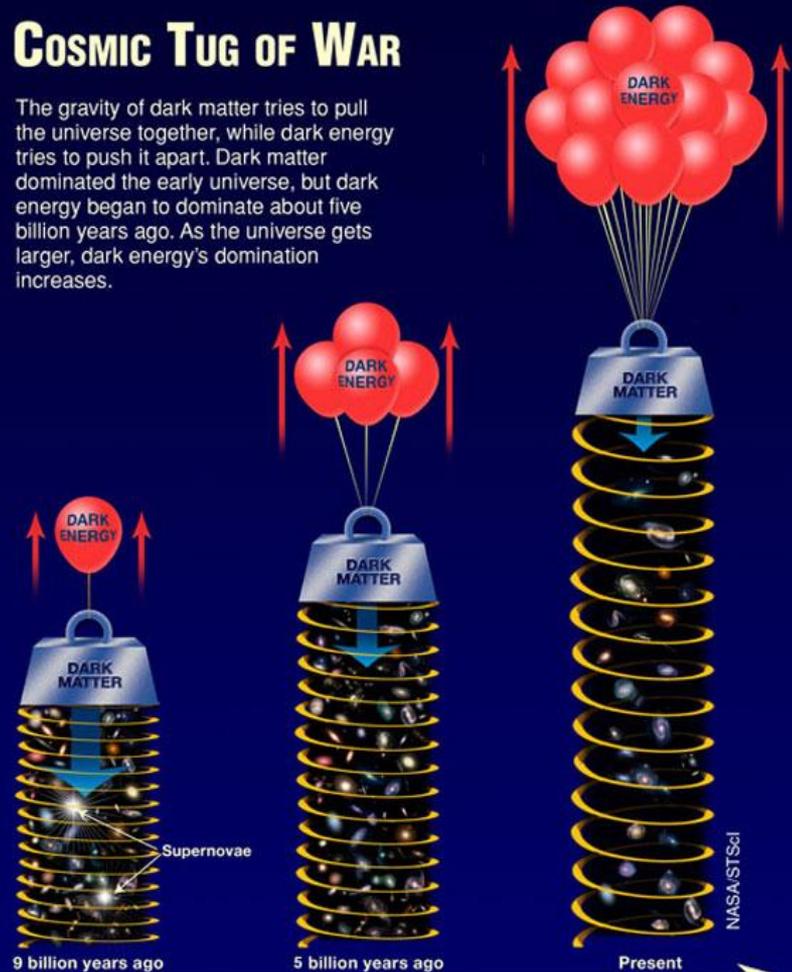
The Sun, along with planets, and all the asteroids, comets, Jupiter sized objects, have formed. It left behind by vast generations of hot

What are dark matter and dark energy?

https://www.youtube.com/watch?v=QAa2O_8wBUQ

COSMIC TUG OF WAR

The gravity of dark matter tries to pull the universe together, while dark energy tries to push it apart. Dark matter dominated the early universe, but dark energy began to dominate about five billion years ago. As the universe gets larger, dark energy's domination increases.

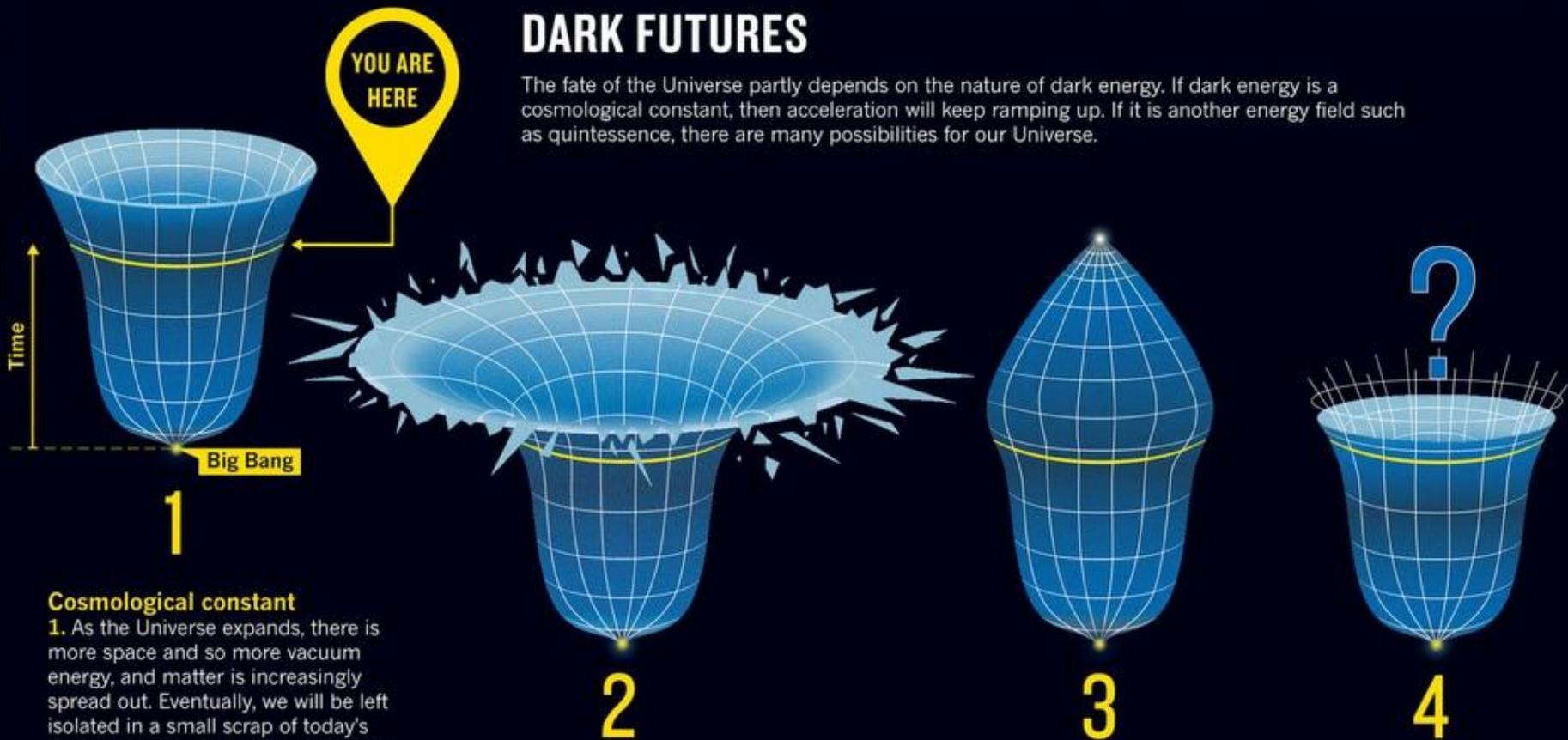


Exit Ticket - 7

1. Is the universe currently in a steady state, or is it expanding or contracting?
2. What did Einstein say was the biggest blunder of his life? Why?
3. What is dark matter? What influence does it have on the expansion of the universe?
4. What is dark energy? What influence does it have?
5. What do you think the universe will do in the future? Speed up, slow down or expand at a constant rate?
6. What do you think is the final fate of the universe? Big crunch, big rip, or just coasting?

DARK FUTURES

The fate of the Universe partly depends on the nature of dark energy. If dark energy is a cosmological constant, then acceleration will keep ramping up. If it is another energy field such as quintessence, there are many possibilities for our Universe.



Cosmological constant

1. As the Universe expands, there is more space and so more vacuum energy, and matter is increasingly spread out. Eventually, we will be left isolated in a small scrap of today's visible cosmos. Over billions of years, most of the known Universe will disappear from view. Only a few thousand galaxies will be visible in the night sky, instead of the hundreds of billions we see today.

Quintessence

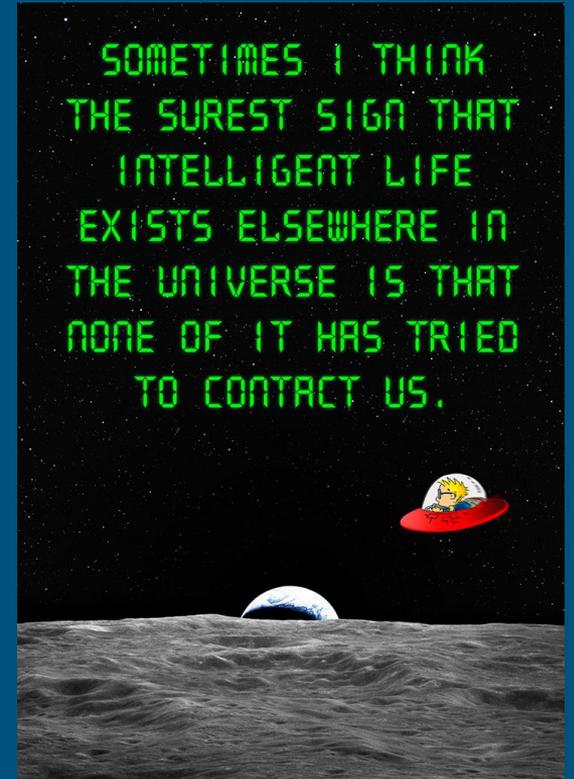
If an evolving energy field rules the cosmos, different possible fates await. **2.** Some theoretical forms of dark energy grow explosively fast, which would shred every atom in a big rip. **3.** Other forms eventually become attractive, pulling everything together in a big crunch. **4.** And others are unstable, liable to decay at some point and give us a Universe that is completely different from the one we inhabit, with different particles and forces.

Exit Ticket - 8

1. Let's narrow our focus on the astronomy project keeping in mind the Driving Question...
 - a. Come up with an idea related to one of the following
 - i. Communication
 - ii. Transportation
 - iii. What needs to be done when you get there?
2. Narrow it to a way that you want to present your learning.
3. Submit this to me.
4. Develop the Rubric.

Driving Question

What are the **most important factors** to **consider** in searching for **complex life** on **other worlds**?



Developed Rubric...

<https://goo.gl/Rahi13>