Contact

Worksheet

This movie is based on the novel of the same name by the famous astronomer Carl Sagan. Sagan was a brilliant researcher, and found that he was even better at describing the wonders of the Universe. He explained science to people in a way that not only could they understand, but so that it also moved them and made them appreciate the awe and majesty of the sky around them. I could write reams about the man and his influence both on the public and astronomers, but that's already been done. Let's talk about the movie instead.

``Contact'' stands out from almost every other science fiction movie ever made in that it went to great pains to be accurate. Almost all of the plotline is based on either solid physics, or extrapolated from current theories. Some of the astronomers were slightly exaggerate in character, but it's safe to say that every stereotype depicted in the movie has seen its moment in real live astronomers. I'm glad that the Ellie Arroways outnumber the David Drumlins though! Mind you, some of the characters are based at least in part on real people: there is a blind SETI astronomer named Kent Cullers (in the movie the character was named Kent Clark). Despite her denials, I think Jill Tartar was in large part the inspiration for Ellie. If Sagan had an inspiration for Drumlin, he never said who it was.

So: on to the questions:

1. In the opening sequence, we pull back from the Earth, listening to radio broadcasts. As we pass the planets one by one, we realize that as we get farther from the Earth, the further back in time the radio broadcasts are.

a. One of the points it is making is that the farther from a source, the farther back in time it appears to be. Light waves (of which radio is a part) travel at 300,000 kilometers per second. The Sun, being about 150 million kilometers away, how long of time would it take for a light wave to reach us here on earth?

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b. As we pull back from the Earth in that opening sequence, the radio broadcast we hear represents that by playing older and older songs and other radio bits as we get farther away from home. Does the radio goes back in time too fast, just right or not fast enough? (Note: We are hearing radio shows from years gone by before we ever leave the solar system.)

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c. If the distance to Pluto from the sun is 5893 million kilometers. How long of time would a light wave take to reach Pluto?

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d. Let’s chalk it up to artistic license. They are trying to make a point, and needed to compromise on the timing. Could they have used another way to show this?

Explain:

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2. As we pull back, we pass the Moon, Mars, the asteroid belt, Jupiter and Saturn. We see Jupiter's Great Red Spot spinning.

a. As far as I could tell, up to this point we are moving in a straight line away from Earth. Should the planets have this type of alignment?

b. Do they show too many asteroids? (On average, there is about 2 million kilometers between asteroids out in the belt).
c. How about the size. Do you think that they overestimated the size of them? (Note: You could be in the middle of the thickest part of the belt and not even see a single asteroid with the naked eye!)

d. As we pass by Jupiter's Great Red Spot, would we be able to see it rotate in that short a time. (Note: The Red Spot is a giant hurricane, over twice the size of the Earth)
c. They also show the Red Spot rotating counterclockwise. Is this a correct depiction? (Note: Hurricanes on the Earth's southern hemisphere rotate clockwise. However, the Red Spot is a high pressure system.) Explain.
3. Still pulling backwards, we pass through the Eagle Nebula.
a. The Eagle Nebula image is probably the most famous Hubble picture ever taken. The composition and color are beautiful, eerie and dramatic. The problem is, in the opening sequence, after we pass through it we see as if we were still seeing it from Earth. Would this be correct from this point of view.? Explain
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4. Later in the movie, we see Ellie Arroway, Upstart Young Astronomer, listening to the radio signals while the telescopes behind her scan the sky for life.

a. Radio telescopes work in much the same way as ``regular'' telescopes: they collect light (in this case, light in the radio frequency) and combine it into a signal. In most cases, the signal is so weak it takes a computer and sophisticated software to actually pull the signal out from all the noise of background objects (and foreground objects too; cars, appliances, everything that runs or uses on electricity can interfere with radio telescopes). So, do you think radio astronomers have a habit of using headphones to listen to the signals? Explain (Note: Astronomers look at millions of ``channels'' simultaneously to try to figure out just which frequency an alien race might use to communicate with us.)
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b. However, as I recall, in the book, Ellie simply like listening to the ``white noise'' of the background static. As it turns out, it pays off, because The Message is so strong that it overwhelms the background. Matter of fact, in the movie they mention the power is about 100 Janskys. A Jansky is a unit of radio energy, and most sources in the sky can be measured in millijanskys (a thousandth of a Jansky). So, how big is 100 Janskys? (Would this allow her to catch it, in her ear-phones)
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c. When we see Ellie listening on her headphones, in the background is the Very Large Array (VLA), a collection of 27 large radio telescopes near Socorro, New Mexico. Is this a real site? (Ask the Internet)
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d. Would her walkie-talkie interfere with the signal being received (when she first hears the Signal, she grabs her radio and starts yelling coordinates to her assistants). (Note: There are multiple dishes involved).
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e. Should they allow cars as well? (Note: At some observatories, the spark plugs from cars messes

up the signal). Could they solve this problem by drive diesel cars?
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5. Ellie says ``You know, there are 400 billion stars out there, just in our Galaxy alone. If only one out of a million of those has planets, and one out of a million of those have life, and just one out of a million of those has intelligent life, there would be literally millions of civilizations out there."
a.. Does a million times a million times a million compare with 400 billion?
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b. What if she meant to say that there are 400 billion stars in our galaxy, and a hundred billion galaxies like our own. How many civilizations would we have in the entire Universe? Is that very many?
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6. In a pivotal scene, Ellie flashes back to the night her father dies. There's a meteor shower, and they have a couple of small telescopes set up.
a. Can you watch meteor showers through a telescope? Explain. (Note: Meteors flash across the sky in a few seconds, while telescopes magnify a small part of the sky.)
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b. It is established later in the movie that her father died on November 10. There are no good showers on that date! The Leonids peak a week or so later, but are usually a fairly weak shower (except every 33 years). She sees a couple of meteors within a few seconds. Does this imply that she is see a dense Meteor shower? Explain.
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7. While receiving the message, the astronomers worry that Vega will set and they'll miss a part of the signal. They set up a worldwide network of radio telescopes to watch Vega.
a. Should have they panicked? Explain.(Note: Vega is circumpolar from Sweden. A star that is circumpolar never sets; for example, Polaris, the North Star never sets for anyone north of the Earth's equator).
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8. When the Machine is activated, some sort of strong gravity field is activated. The ships in the harbor all lean toward the Machine.
a. Would this be correct? Would the ships should heel the other way, so that the decks lean away from the Machine. Why? (Note: Buoyancy works such that the deck of the ship will float horizontally with respect to gravity. A ship in still water will have the deck perfectly horizontal).
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9. When Ellie travels to Vega in The Machine, she sees a beautiful blue star surrounded by a thick cloud of particles.
a. Vega is indeed surrounded by a cloud of dust. It was discovered in the 1980s. Astronomers

noticed that Vega put out too much infrared (IR) light compared to other stars of its type. That means something nearby must be emitting IR, and the most common source of that is dust. Vega is also a young star, and young stars commonly have disks or clouds of material around them. These clouds are left over from the formation of the star, and after billions of years they get blown away by light pressure and the solar wind. Vega is too young to have completely swept away its cocoon. Does the movie have too much dust around Vega? Explain. (Note: Measurements show that the total amount of dust is about one-half the mass of the Moon.)
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b. It wasn't as clear as it could be in the movie, but the aliens were not from Vega. They had an automatic radio telescope of sorts orbiting the star, listening to nearby stars. That's how they detected us. We don't know from where the aliens themselves came, but I'll note that just before Ellie is whisked away from Vega by the wormhole, is there some sort of array that can be seen?

10. When Ellie returns to Earth, 18 hours have passed for her, but no time at all has passed on Earth.
a. What is implied is that the travel through the wormhole took no time at all, as if she were moving at some super-relativistic speed. Einstein showed that an object moving near the speed of light relative to some outside observer has time slow down relative to that observer. It's possible, if you fudge it a bit, to assume that no time elapses at all if you are moving faster than light, which Ellie did. However, she had a conversation with her ``father''. That conversation took up time. No matter what, some small amount of time must have elapsed during her trip. Will this cause a problem with the aliens? Explain how they might have got zero-time trip out of it:
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Conclusion:
A lot of what I have said here may sound like real nitpicks. I fully admit that's true. The reason is that this movie is almost unrelentingly accurate, and beside a few bigger mistakes, the only ones to find are pretty small!
If you liked the movie, or even if you didn't, you really should read the book. It's a lot better than the movie, and has many concepts only hinted at in the movie.