Part 1: TIME

Biblical Time
The world is about 6,000 years old. We have been here since the 6th day.
6 days is about 0.25% of six years.   0.025%   of 60 years
          0.0025%   of 600 years   0.00025%   of 6,000 years.
          100.00000% – 0.00025 % = 99.99975% of the time
So we humans have been here for over 99.999+% of the history of the world.

PowerPoint: Show NGC 253   Had I discovered a comet? [**See marks on left side, midway from top to bottom**]
          Note PGC 198196 [Principle Galaxy Catalogue]   It is almost **a billion light** years away.
"A billion years ago, the most intelligent life on earth was algae." (Carl Sagan)

Deep Time -- Age of Earth. The earth is 4.7 billion years old.
Professor Laird Lose: Let's let the distance between my fingertips represent 4,700,000,000 years.
Homo sapiens has been here 200,000 years. What would this distance look like without us?"[1]
It's just the reverse of biblical time.

Deep Time -- Universe
Now we know that "God created the heavens and the earth" is an oversimplification.
The earth is 4.7 billion years old.   Scientists date the "big bang" to 13.7 billion years ago.
The universe had already existed for 9 billion years before the earth formed!
          The entire universe is 3 times as old as the earth. (Better brush the nail file only once!)
hydrogen & helium   heavier elements in stars   2nd and third generation stars have heavier elements
Every bit of iron in your blood came from a star!

PowerPoint: M84, M86 & Companions   Quasars   6.0 & 6.2 **billion** light years away.

Part 2: SPACE

Watch this You-Tube video first.
I don't know how to get a YouTube video into my lecture. I have put in a few "screen shots."
However, you will do much better to view the following YouTube Video (2min 44 seconds)
          before watching my lecture.
The Largest Star, VY Canis Majoris   https://www.youtube.com/watch?v=smmNP8G69vc
Then view my Lecture Video

Space: Size of planets & stars (diameters in miles)
Planets: Moon (2,000r), Mercury (3,000), Mars (4,000), Earth (8,000) Neptune (30,600), Saturn, Jupiter (80,000)
Stars: Sun (865,000), Sirius, Arcturus (40,000,000), Aldeberan, Rigel, VY Canis Minoris (1,235,000,000)

Space: Number of Stars in the Galaxy
PowerPoint: Let NGC 253 "stand in" for Milky Way
100 Billion Stars [actually it is 300 billion]

Stop the Lecture Video! I do not know how to incorporte this directly into my presentation.
Clip from Stephen Hawking's PBS Video *Genius*[2]

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[1] Professor Laird Close, U. of Arizona, *Life In Our Universe* Video, The Great Courses 2013.

[2] The set of *Genius* videos featuring Stephen Hawking is available from PBS at a very reasonable price!

https://www.youtube.com/watch?v=d-nEidcLYJU&index=14&list=PLhQ6BGDCY-77rpkbK1-sMBWKIL06ncLn-
Then Resstart the Lecture Video!

If **really** recommend you watch the video clip, but I have a few "stills" if you are having technical diffculities
> **How much sand will it take to represent the Milky Way Galaxy if one grain of sand = the sun?**
> 1 grain of sand = the sun
> 1 spoon of sand = 50,000 stars like the sun
> they guess how many stars in the galaxy: millions? a billion? a hundred billion?
> they decide to weigh the spoonful of sand. turns out to be 70 grams.
> 100 billion grains would be 140,000 kilograms (about 150 **tons** of sand).
> The decide they will try for only **one** billion stars.
> They decide weigh a bucket of sand to see how many buckets they will need.

A Billion Stars A piles as big as my podium

300 Billion Stars. 450 **tons** of sand!   A pile as big as the lecture hall! And the sun is represented by a single grain!

Space: Size of Milky Way. Suppose we have 450 tons of sand, one grain for each star in the Milky Way
> Actually we would need a few thousands baseballs & softballs for the big ones
> And a few dozen beach balls for the really big stars.

Where are we going to spread this out for it to be to scale? Shreveport? Louisiana? North America!
If we reduced the sun to the size of a grain of sand, a map of the Milky Way would be as large as **North America**.
But the stars would not necessarily be on the surface! They could be anywhere within 50 or 60 miles of the surface
> The earth would be the size of dust mote (micron) 1.5 meters (1 1/2 yards) away.
> Diameter of Neptune's orbit (60 AU), about 90 m, ca 100 yards (size of a football field)
> Diameter of Pluto's orbit (ca 120 AU) would be about 180 yards (like an entire football stadium)
> A light year would be 1 km, a little over half a mile

The nearest star would be another grain of sand about 4 km (2.5 miles) away from the sun.

PowerPoint: **Show NGC 253 again.**
Let's pause. We now have an idea of the scale of our galaxy. The Sun is a grain of sand.
It takes light (going 186,000 miles every **second**) 100,000 **years** to go from one side to the other.

Edwin Hubble. 100 years ago, this was the size of the universe. A glove about 100,000 light years, in diameter.
> That would be 6,000,000,000,000,000,000 miles in diameter

Hubble discovered that the "**spiral nebulae**" -- thought to be within the Milky Way Galaxy --
> were actually external galaxies! Other "Milky Ways," if you will!

PowerPoint: Show Hubble Deep Field
The **Hubble Deep Field** (**HDF**) is an image of a small region in the constellation Ursa Major, constructed from a series of observations by the Hubble Space Telescope.   **It shows 10,000 galaxies![3]**

How Much Sky Are We Looking At? [4]
It covers an area about 2.6 arcminutes on a side, about one 24-millionth of the whole sky, which is equivalent in angular size to a tennis ball at a distance of 100 metres.

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[3] I mis-spoke it is "only" 3,000! It is the Hubble **Ultra Deep Field** -- a longer exposure -- that shows 10,000.

[4] https://en.wikipedia.org/wiki/Hubble_Deep_Field. . . . [The images were taken on] ten consecutive days between December 18 and December 28, 1995. The field is so small that only a few foreground stars in the Milky Way lie within it; thus, almost all of the 3,000 objects in the image are galaxies, some of which are among the youngest and most distant known.

Or, look at the sky through a **soda straw**. That is how much sky this picture covers.
Or, put a grain of rice on your finger tip, and hold it out at arms length. That grain covers the picture.

> That grain covers 3,000 galaxies?[5]
> **How many galaxies do you think are in the part of the sky the grain of rice does not cover?**

Current Size of the Universe. Comoving Distance Radius.
Most Distant Galaxy, ca. 13,500,000,000 light years away.
Diameter of the **observable** universes is 27,000,000,000 light years
Since the universe is expanding, we see objects whose light has been travelling 13.5 billion years.
But **now** they are much further away than when that light started moving toward us!
They are now **50 billion** light years away, so the diameter of our universe is currently 100,000,000,000 light years.

> Each light year =, 6,000,000,000,000 miles has a diameter of 600,000,000,000,000,000,000,000 miles
> So the **observable** universe

But we cannot see the whole thing.
Most of the universe is moving away from us faster than its light is coming toward us! That light we never get here!
Most of the universe is not part of our **observable** universe.
So how much can we see? At this point nobody is sure. Scientists give various estimates.

> We might be able to see **only one percent** of the total! Maybe more, maybe less.

Challenge for Theology. Not: "Is there a God." Rather, "Does the God who does all this even know we are here?"

A Dust Mote. The Sun is a grain of sand. **The earth is a dust mote.**

Reading Suggestion. Haught, John F. *God After Darwin, A Theology of Evolution*, Westview Press, 2000.
He knew the great Jesuit astronomer Father William Stoeger, S.J.

Stoeger, William. *Creation and the God of Abraham*. Cambridge University Press, 2010. Paperback 2013.
Creation can never be a scientific concept. But it is a worth topic for discussion by theologians & philosophers!

Schmisek, Brian. *Resurrection of the Flesh OR Resurrection from the Dead: Implications for Theology.* Liturgical
> Press, 2013. Especially chapter 3 "Our Vast Knowledge." Scroll down to my full review on Amazon!

Our Vast Ignorance --How much we don't know!
> Matter & Energy are only 5% of the universe. We don't have a clue what the other 95% is!

Do not take refuge in **The God of the Gaps**.
Pay attention to **Religious Experience.**

 Power Point: Old Testament Cosmology
A very small "friendly" universe. The Lord is "enthroned above the flood" i.e., the waters above the "firmament."

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[5] Correction. I said 10,000 galaxies. The Hubble Deep Field covers "on" 3,000. It was the Hubble Ultra Deep Field -- an even
longer exposure -- that shows, 10,000!