

Science and Religion : there does not need to be a conflict

I. A Scientific Theory Case Study : Stellar Evolution

- Overview : what is it?
- Why should we accept it?
- Why it argues for a 13-billion-year-old Universe

II. What is a Scientific *Theory*

- The Scientific Method
- Four Sample Theories

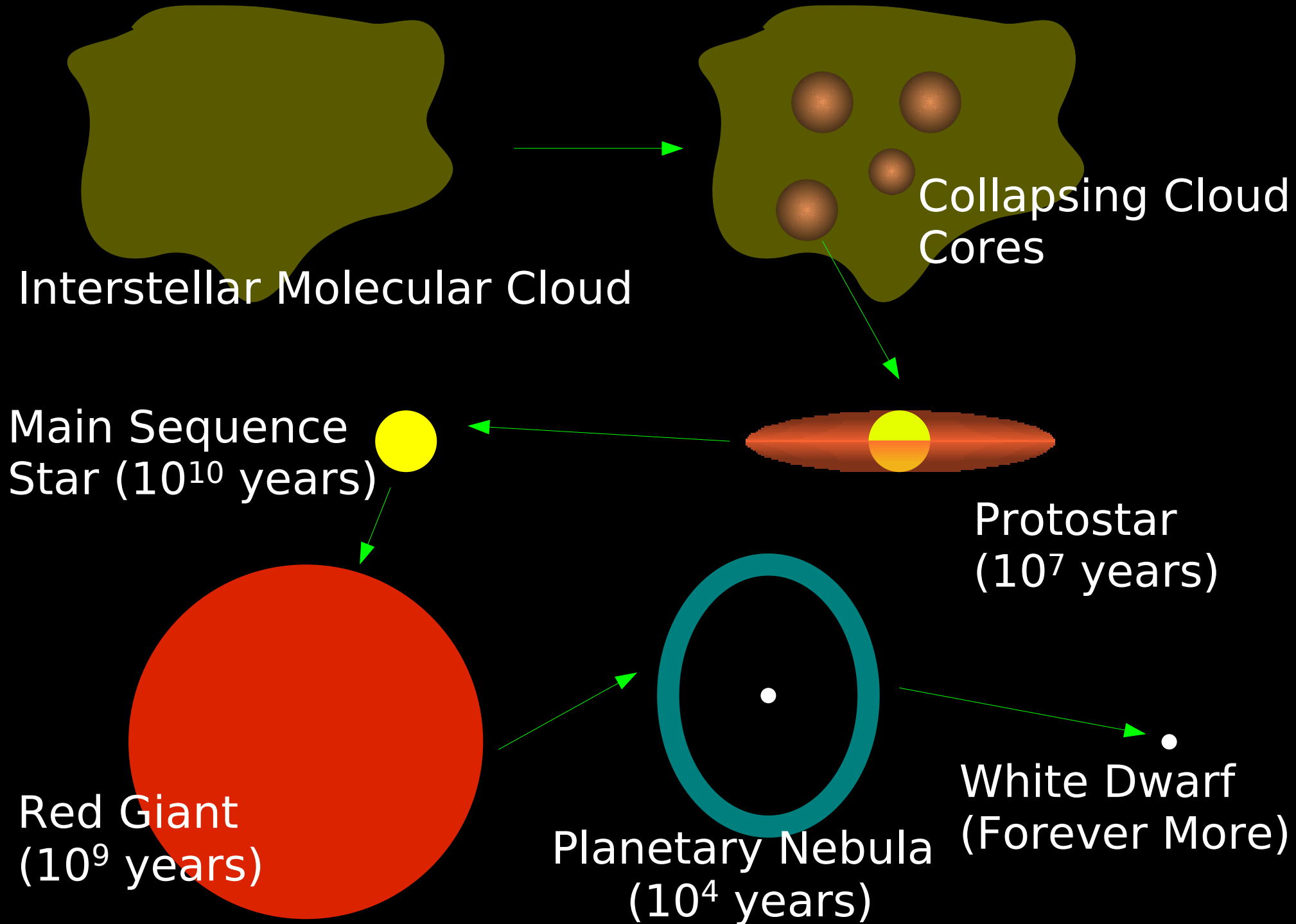
III. Science “vs.” Religion

- What is the Scientific Worldview?
- Science does not prove or disprove God
- A trap : “God of the Gaps”
- A trap : Deny knowledge to support religion

IV. A Positive View of God

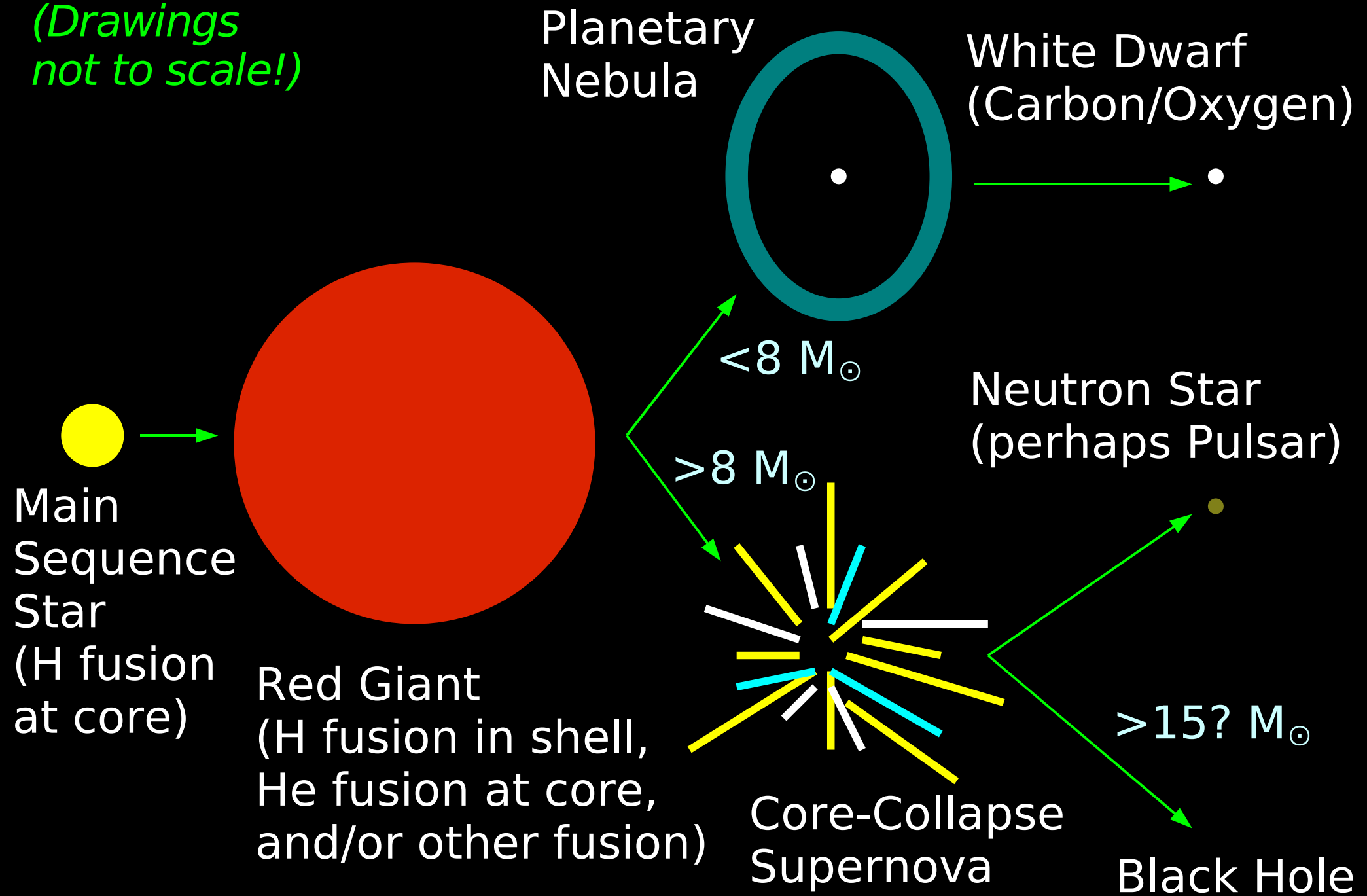
(Drawings not to scale)

Evolution of the Sun



Overview of Stellar Evolution

*(Drawings
not to scale!)*



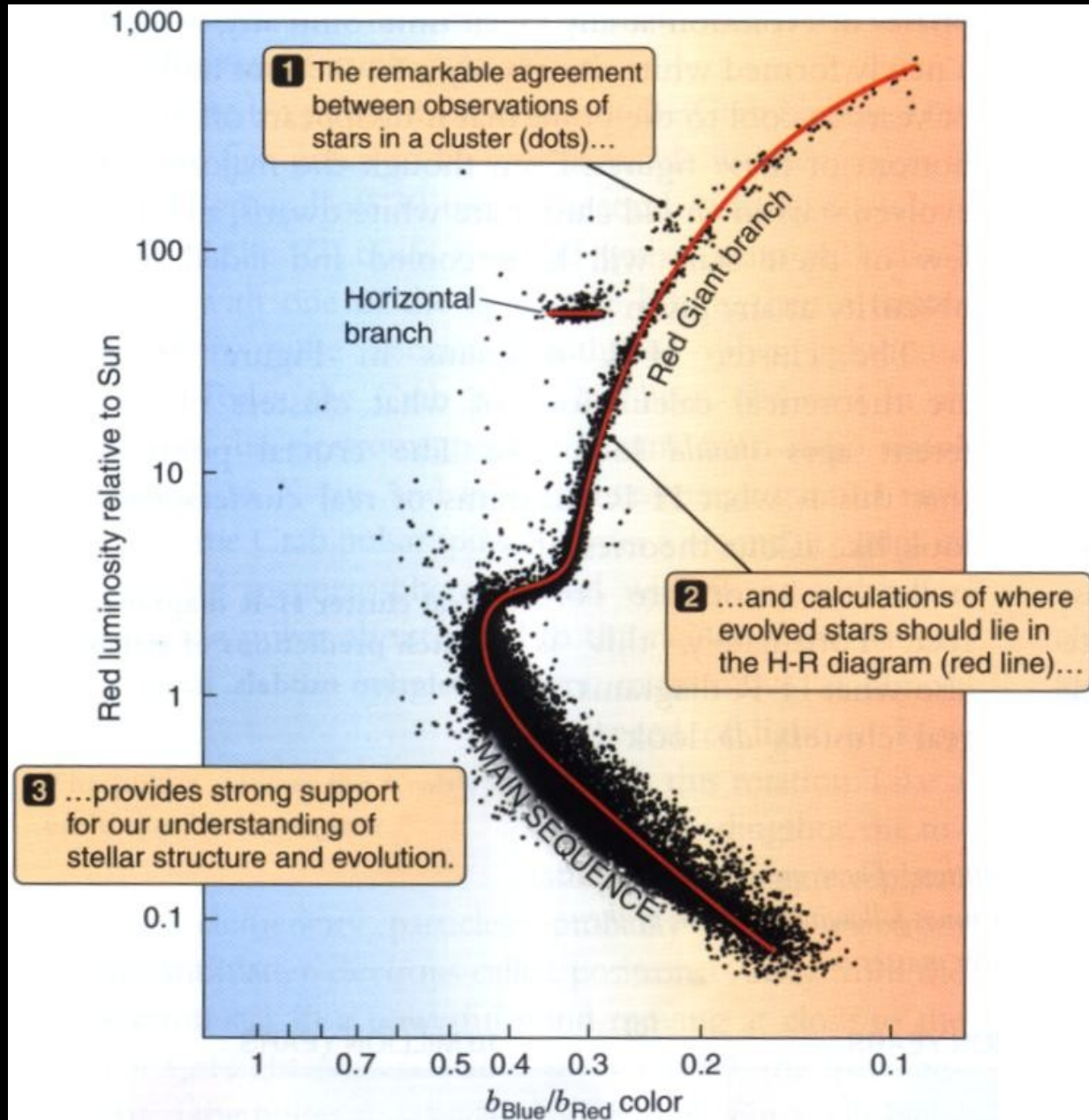
Why accept this theory of Stellar Evolution?

Even the most massive stars live millions of years. We haven't been able to watch any star go through the stages of life that we predict from our theories of stellar evolution.

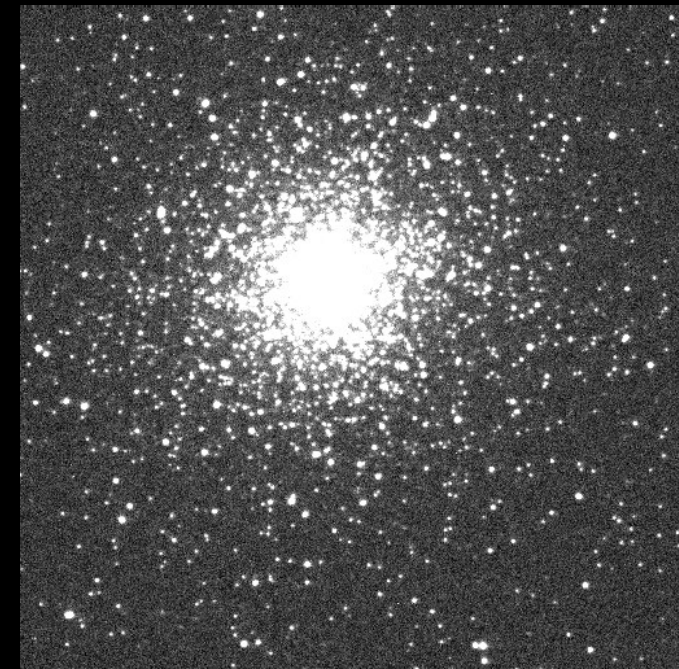
How then can we be sure that our theories are right? How can we even hope to test our theories?

Perhaps, even, might we say that this kind of astronomy isn't a "real" science, since it doesn't make predictions of future experiments we'll be able to observe? Indeed, given the speed of light, we're looking at stars as they were more than a lifetime ago – not at a future experiment!

One prediction of Stellar Evolution : Luminosities & Colors of Stars in a Cluster



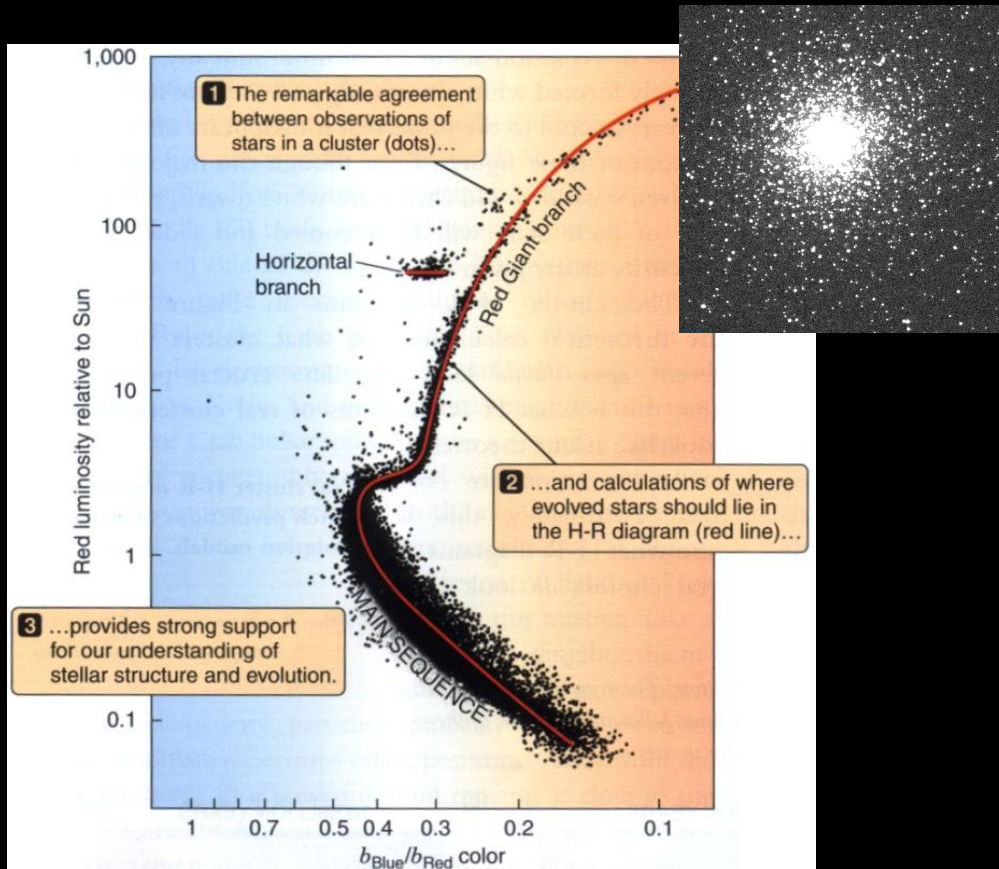
Age in calculations:
13 billion years



47 Tucanae

Plot: Bennet et al., "21st Century Astronomy"

What do we learn about the age of the Universe from Stellar Evolution?



The oldest globular clusters in the Milky Way are 13 billion years old...

...ergo, the Universe must be *at least* 13 billion years old!

You can't escape this conclusion unless you claim our theory of stellar evolution – or perhaps the process of science itself – is fundamentally wrong. To reasonably do this, you'd need to supply an alternate theory that explains the observations equally as well or *better*!

Quotes which, while not strictly incorrect given scientific definitions of the terms, are extremely misleading and *incorrect* in intent:

“Evolution is a theory, not a fact!”

“The Big Bang is a theory, not a fact!”

In Science, “theory” *does not* mean “speculation”

(One of many cases where the scientific definition of a term and the “popular use” definition of a term do not exactly line up.)

“Truth”

The ultimate (unattainable?) goal: What is nature?

When do we consider a theory “right?”

THEORY : a quantitative and descriptive framework that explains a set of natural phenomena and successfully describes the results of experiments or observations about the natural world.

Experiments test models, or models explain experiments

When is a model enough to be called a theory?

Model

Experimental Result

Results of an experiment or observing program

via processing/analysis/interpretation of data, understanding uncertainties, etc.

Truth

Fact

Individual observation or piece of data

Experimental Design

“Theoretically Impossible”

= not possible *in principle* given our best current understanding of nature

This is a stronger statement than “you think it can't be done”.

Example : for a red light to look green, you must be driving 100 million mph towards that light. This is impossible for any car available right now... but is perfectly possible in principle.

It is *theoretically impossible* for anything to go faster than 670 million mph, the speed of light.

THEORY : a quantitative and descriptive framework that explains a set of natural phenomena and successfully describes the results of experiments or observations about the natural world.

Theory of Stellar Evolution : describes how stars change from initial formation through an end as a supernova or white dwarf.

Supported by many observations, including H-R diagrams of clusters.

Doesn't say anything directly about the formation of the Universe, the nature of human consciousness, or the price of tea in China.

THEORY : a quantitative and descriptive framework that explains a set of natural phenomena and successfully describes the results of experiments or observations about the natural world.

Theory of Biological Evolution : describes how biological organisms change over many generations. Describes how one ancestor can lead to a host of descendant species (“common descent”), and how organisms present today have developed from organisms present earlier in the Earth's history.

Supported by evidence in DNA, the fossil record, and direct observations of bacteria and isolated species populations.

Says nothing about the formation and evolution of stars, the original development of life on Earth, or the rate at which a dropped apple will fall.

THEORY : a quantitative and descriptive framework that explains a set of natural phenomena and successfully describes the results of experiments or observations about the natural world.

Newton's Theory of Universal Gravitation : describes the force by which massive objects attract each other.

Supported by vast numbers of observations of things dropped on Earth, by the orbits of planets and spacecraft around the Earth and the Sun, and other observations.

Fails to precisely predict the orbit of Mercury, gravitational lensing, and incorrectly suggests gravity travels at infinite speed.

Is it *wrong*? Better to say that it is incomplete; a deeper theory makes the *same* predictions where Newton's gravity is applicable!

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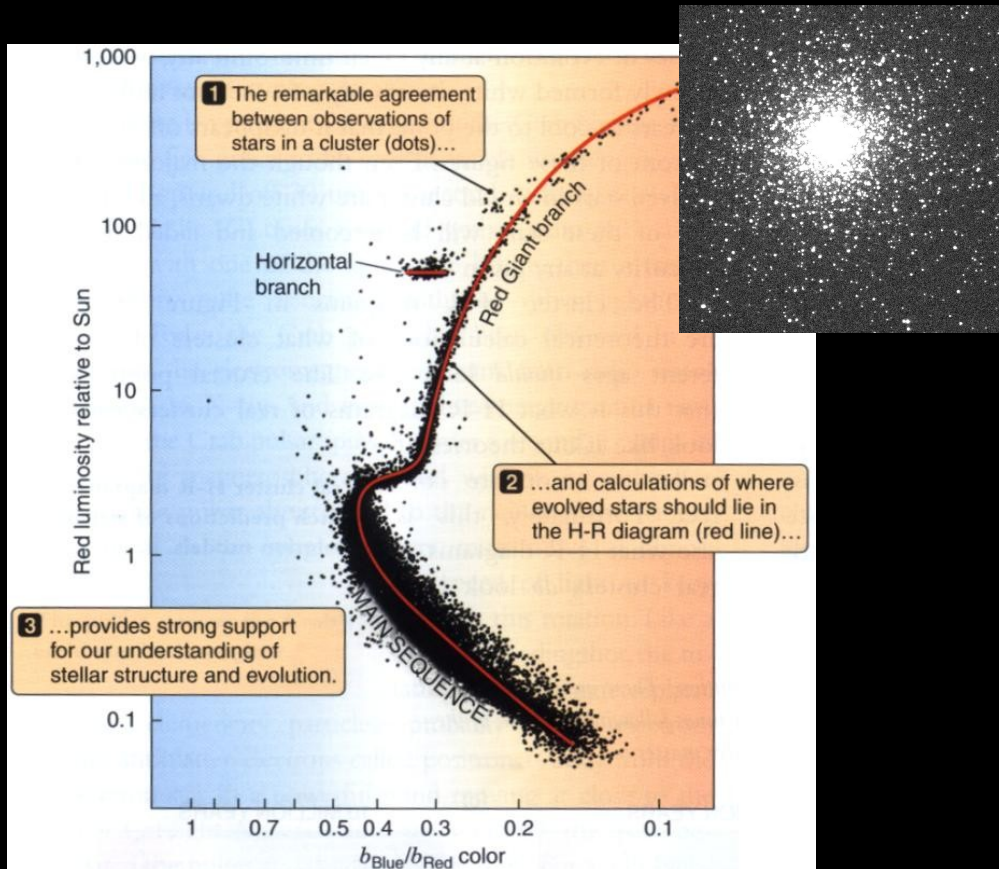
The Theory of General Relativity : describes gravitational attraction as motion through curved spacetime; describes how mass curves spacetime.

Consistent with Newton's gravity where Newton's gravity works. Predicts Mercury's orbit and gravitational lensing. Its predictions are needed to make GPS satellites work!

Is not consistent with Quantum Mechanics (another well-supported theory) where the two intersect. Is it *wrong*? No, but almost certainly GR is incomplete.

At the moment, we have no working theory of “quantum gravity”. (Maybe String Theory?)

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Science “vs.” Religion

There does not need to be a conflict!

You can find atheistic scientists who will claim that the scientific worldview is inconsistent with belief in any kind of God (e.g. read some of the writings of PZ Meyers on scienceblogs.com/pharayngula).

Many religious people claim that the scientific worldview, and much of the knowledge of modern science (e.g. evolution, a 14-billion year old Universe) is inconsistent with religion, and indeed a *threat* to religion!

I strongly disagree with both of these assertions.

The Scientific Worldview :

- There is such a thing as objective reality.
- Much, if not all, of the mechanisms and processes of nature *can* be understood.
- Our natural curiosity about ourselves and the world around us drives to try to understand nature, and this is a worthwhile pursuit.

Science says nothing about the existence of God, nor can it disprove God. For many, religion provides meaning in a way that science cannot.

Science is concerned with explaining the mechanisms of natural processes – *how things work*.

Why have any truck with the scientific worldview?

Track record! Over the recent centuries, science has done a remarkable job of explaining and understanding nature.

It doesn't *have to be* that nature is understandable.

Yet, we have explained and done so much starting from that assumption that the assumption sure looks like a good one!

Note: many people find spiritual inspiration or a sense of wonder/spirituality from the science they perform : understanding and admiring God's Universe, as it were.

Personally, I find as much spiritual inspiration in humanity's ability and endeavor to understand the Universe! This spiritual inspiration itself is not science, but akin to the inspiration one gets from listening to (say) Beethoven's 9th.

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Science is concerned with explaining the mechanisms of natural processes – *how things work.*

Science *can* conflict with specific claims made by religions!

Example 1 : Galileo, 1600's. The Church considered it essential to Christian theology that the Earth be at the center of the Universe, with the Sun and everything else going around it. Galileo made inconsistent observations, and got in a lot of trouble: he was considered a threat to the faithful. Today, we know the Sun is at the center of the solar system... and we also know that Christianity is doing just fine without the Earth at the center!

Science *can* conflict with specific claims made by religions!

Example II : The 14-billion year old Universe. We *know* that the Solar System has to be 4.6 billion years old. We *know* that the oldest stars in the Universe are 13 billion years old.

This is inconsistent with the claims of Young-Earth Creationists who base their age estimates on the creation story in *Genesis*.

Given modern scientific knowledge (unavailable to the human authors of *Genesis*), the claims of Young-Earth Creationists are **wrong**! We don't know everything, but we know *something*.

To dispense with the 13-year old Universe, we must dispense with stellar evolution... but it explains so *much* that must then otherwise be explained! That is a huge burden of proof.

You *can* be a Christian without accepting all of *Genesis* (and the rest of the Bible) as literal, declarative, factual truth!

As a Christian, I view the creation story in Genesis as a *story*, not literal history – fiction that can, when thought about creatively, help us understand our relationship with God.

Something need not be *literally* true to contain truth. Even Jesus taught with stories – parables!

The “Clergy Letter Project”

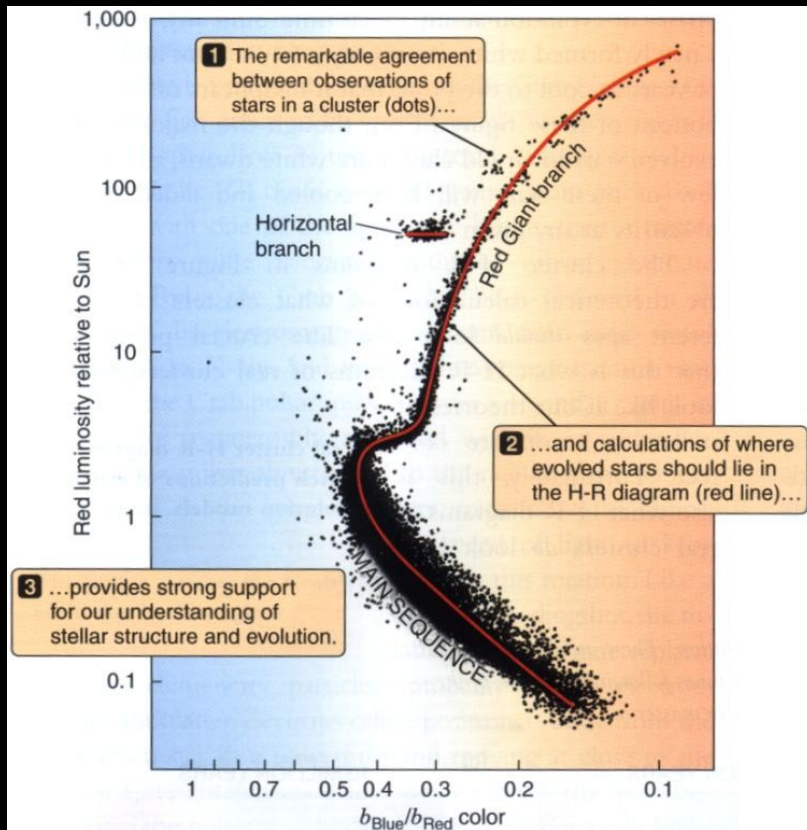
http://www.uwosh.edu/colleges/cols/clergy_project.htm

“On Being a Scientist and Not an Atheist”

<http://brahms.phy.vanderbilt.edu/~rknop/blog/?p=42>

The same holds for most any other religion.

“God Did It” is not a *scientific* explanation



“The stars in globular clusters have those luminosities and colors because God decreed that they should.”

Perhaps... but that's not science.

Science seeks natural explanations, and is based on understanding, evidence, and explanation, *not* on revelation or declared authority.

Why should we think these natural explanations are valid? Again, track record!

A Trap : “God of the Gaps”

Something unexplained by science is *not* scientific evidence for God ; it is merely evidence that we don't know something (yet).

Lightning Bolts \Rightarrow Anger of Zeus

“Irreducible Complexity” \Rightarrow Intelligent Design

These are the same mistake ; if you base your belief on things not currently explained fully by science, you risk having your faith disproven by future discoveries!

A Trap : Denying Knowledge to Support Faith

If your religion states things at odds with what the intellectual human endeavor has learned, either your religion is wrong, or you need to re-examine your interpretation.

Why base faith on denial of knowledge???

The Galileo Affair : Christianity does not really depend on a geocentric Solar System, but at the time many (mistakenly) thought it did.

Creationism : Christianity does not depend on denying evidence for evolution or for the 13.7-billion-year-old Universe!

“Irreducible Complexity” : the eye, and many other things, *have* been explained evolutionarily!

Suggestion: take a positive view of God

(Negative views : explaining gaps in scientific knowledge ; justifying a worldview that rejects science. Defining God by what God isn't and by what God rejects.)

One idea:

A layer of reality that is not addressed by naturalistic means, but which loves you can provide spiritual and emotional support in times of joy and sadness

Another idea:

An collective property of human (self-aware, thinking) existence. E.g., the angels and interventions are the people who, perhaps moved by their faith, come to the aid of others. Perhaps it is our search for God and our thoughts about God that illuminate God.

In reality : as a non-materialistic and Universe-spanning concept, it is difficult (impossible?) to summarize God in a pithy statement, or even on one slide as one can do with the scientific method.