ASTR 202 – Life in the Universe

“An Introduction to Astrobiology”

Professor: Yancy Shirley (N310)
Teaching Assistant: Russell Knox (D221)

Course Materials:
The textbook for the class is Life in the Universe.
Readings will be posted online on the course webpage:
http://eldora.as.arizona.edu/~yshirley/Arizona/AST202/
Goals of the Course

• Learn how scientists are trying to answer a very big question: is there life beyond the Earth?
• Become familiar with one of the most exciting and interdisciplinary areas in all of science
• Show you how scientists evaluate evidence and learn better how the natural world works
• Engage you in the process of science and let you actively participate in your own learning
NOT Goals of the Course

• Turn you into astronomers or scientists
• Get you to memorize facts and jargon
• Let you think that I have all the answers
• Evaluate you with multiple choice tests
TextBook
The Web Site

http://eldora.as.arizona.edu/~yshirley/Arizona/AST202/

ON THE WEB SITE:
• Syllabus, our calendar
• Homeworks & Activities
• Powerpoint lectures
• Weekly readings

Class Syllabus

Life in the Universe is a scientific introduction to the burgeoning field of astrobiology. The main goal for students in this course is to have fun learning about the possibilities for life in the Universe and, in the process, gain an appreciation for the methods used in science.

CURRENT SCHEDULE (subject to change)

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Th Jan 10</td>
<td>ILC 150</td>
<td>Introduction to Astrobiology (slides) (Example A+ Creative Project)</td>
<td>Life in the Universe Chap. 1</td>
</tr>
<tr>
<td>Tu Jan 13</td>
<td>ILC 150</td>
<td>How Science Works</td>
<td>Life in the Universe Sec 2.3-2.4</td>
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</table>
• I research how stars and planets form and study space chemistry
• My research includes projects on Space telescopes and ground-based radio telescopes
• I used to work at the Very Large Array in New Mexico
• I am a UofA alumnus (class of ‘97). **BEAR DOWN!**
• I was born in Indiana, but have lived in Tucson for over 10 years.
1. To actively participate during class activities
2. To ask questions and come prepared to learn
3. To use the project to deepen your knowledge
A few notes about **BEHAVIOR**

- Be courteous to each other, the TA, and me
- No eating, drinking, or paper reading in class
- Turn those pesky cell phones and pagers off
- Please do not come late, sleep, or leave early
- You can drop scores, so no late work please
- Follow the UA Code of Academic Integrity
- Always do your own work in this class

Let’s all keep the classroom a *respectful* learning place!
Grading Scheme

• Absolute grading in this course
  – no curves
  – no competition
  – no final, no multiple choice

• 4 Exams (drop 1) 35%
• Homework/Activities (drop 1) 45%
• Creative project 20%

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>90 – 100%</td>
<td>A</td>
</tr>
<tr>
<td>75 – 89.9%</td>
<td>B</td>
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<tr>
<td>60 – 74.9%</td>
<td>C</td>
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<tr>
<td>50 – 59.9%</td>
<td>D</td>
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<tr>
<td>&lt; 49.9%</td>
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No plus or minus grades

All grades in this class are final 1 week after they are posted or work is returned. Contact us BEFORE the 1 week period if you find work that is missing, or you have a grading dispute. Project deadlines (the plan and the final submission) are in the syllabus.
The Syllabus is our “Contract”

• *Class meets Tu/Th 11:00am – 12:15pm. You need to attend regularly to succeed so come to class!*

  No attendance is taken, but…

  Material for activities and exams are based on readings online and lecture material

  Keep up with reading; it helps with lectures!
The Syllabus is our “Contract”

• *Class meets Tu/Th 11:00am – 12:15pm. You need to attend regularly to succeed so come to class!*
• *In-class group activities will occur regularly.*

Activities build on preceding classroom lectures

Group assignments = work together!

No make-ups given but lowest score is dropped

45% of grade.
The Syllabus is our “Contract”

• *Class meets Tu/Th 11:00am – 12:15pm. You need to attend regularly to succeed so come to class!*

• *In-class group activities will occur regularly.*

• *Everyone is expected to do a semester-long creative project, most individually but possibly in pairs.*

Submit 1 paragraph plan by Mar 07

Final project due Apr 30 (firm)

Graded equally on its science content and its creativity

20% of total, 1/5 of grade
The Syllabus is our “Contract”

• *Class meets Tu/Th 11:00am – 12:15pm. You need to attend regularly to succeed so come to class!*
• *In-class group activities will occur regularly.*
• *Everyone is expected to do a semester-long creative project, most individually but possibly in pairs.*
• *The project lets you to combine astrobiology with another of your interests or talents.*

Risk-taking and originality will be rewarded!!
Example “A+” Creative Project

- http://www.youtube.com/watch?v=QrKmBNFRJHs
# Weekly Schedule

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<tr>
<th>Time</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
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<tr>
<td>10:00am</td>
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<td>11:00am</td>
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<td>CLASS</td>
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<td>1:00pm</td>
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<td>2:00pm</td>
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<td>3:00pm</td>
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<td>4:00pm</td>
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<td>5:00pm</td>
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IMPORTANT DATES

EXAM #1               Feb 05
EXAM #2               Feb 28
Creative Project Proposals Due  Mar 07

EXAM #3               Apr 02
EXAM #4               Apr 25
Creative Project Due @ 11am   Apr 30

(NO FINAL!)
Last Comments

- Refer to paper syllabus, or website, for details
- Email or call me, or pick a time to stop by
- *Never be afraid to think “outside the box”*
- Ask questions, work hard, enjoy the course
- The truth is out there; I hope it’s not hungry
The Science of Astrobiology

...the pale blue dot, is it unique?
We are conditioned by the popular culture to believe in aliens, or to think they have already visited, but what’s the scientific evidence for life in the universe any other place than Earth?
Astrobiology is Interdisciplinary

- **Astronomy** and the laws of **physics** give us a cosmic context for life in the universe
- Stars show us that **chemistry** is universal
- **Planetary science** tells us about the number of habitable worlds
- **Biology** informs us about life processes and their range on Earth
- **Geology** tells us how the environment acts to shape evolution
- **Sociology** and **anthropology** give us a hint of the role of intelligence and technology
Evidence that organic molecules form easily and naturally

Evidence that life appeared early in the history of the Earth

Biology may be common in the universe

Evidence that Earth life can survive under a wide range of conditions
Where Should We Look?

Explore the potential sites for life in the solar system

Explore the full range of life on the Earth itself

Find habitable planets around Sun-like stars

Listen and send signal to find the forms of life with technology
Topics We Will Cover:

- Astrology
Topics We Will Cover:

History of Astronomy
Cosmic Epochs

- Big Bang
  - Radiation era
    - ~300,000 years: "Dark Ages" begin
  - ~400 million years: Stars and nascent galaxies form
- ~1 billion years: Dark ages end
  - ~4.5 billion years: Sun, Earth, and solar system have formed
  - 13.7 billion years: Present
- Galaxy A1689-zD1: ~700 million years after the Big Bang
Topics We Will Cover:
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Four exosolar planets around the star HR 8799
Imaged with PISCES at 1.6 microns and LMIRCam at 3.3 microns
A. Skemer et al. 2012
Classed as a “super-Earth,” candidate planet KOI (Kepler Object of Interest) 172.02 orbits within the habitable zone of a sun-like star. This means the planet, which has yet to be confirmed by follow-up observations, could have liquid water on its surface, thought to be essential for life.

### KOI 172.02 vs. Earth

<table>
<thead>
<tr>
<th></th>
<th>KOI 172.02</th>
<th>Earth</th>
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<tbody>
<tr>
<td>Diameter</td>
<td>11,900 miles (19,000 km)</td>
<td>7,926 miles (12,756 km)</td>
</tr>
<tr>
<td>Orbital distance from star</td>
<td>70 million miles (112 million km)</td>
<td>93 million miles (150 million km)</td>
</tr>
<tr>
<td>Year in Earth days</td>
<td>242 days</td>
<td>365 days</td>
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</tbody>
</table>

*ARTIST’S CONCEPTION. PLANETS AND STAR SHOWN ENLARGED COMPARED WITH ORBITS*
I WANT TO BELIEVE
Topics We Will Cover:

SETI
Topics We Will Cover: