

## Astronomy 1143: Extra Credit Assignment

This *optional* extra-credit assignment is due on Wednesday, November 28. It can be turned in in class or delivered to my mailbox in 4055 McPherson Lab *by 5 pm*. It will be graded on a 4-point scale and added to your average course grade from other assignments, with a weight equal to that of one homework assignment (10% of the total course grade). For example, a grade of B+ (3.33) on this assignment would raise your course grade by 0.333, the difference of B to B+, B+ to A-, etc.

You have a choice of three topics. For each, you will need to do about three hours of background work or research, then write a 3-page (typed, double-spaced) essay. (More specifically, your essay should be more than 2 pages and less than 5.) Essays will be graded based on clarity of expression and level of insight — a good essay should be well organized and well written, and it should have something interesting to say. Although the essay is short, the usual standards of quality apply: an “A” grade corresponds to an excellent essay, a “B” grade to a good one, etc.

Your essay must be in your own words, and you should clearly identify any direct quotes from other sources; stringing together a bunch of quotes or paraphrases is not the same thing as writing an essay. You do not need to give detailed footnotes, but if any sources besides those listed below play an especially important role in your essay you should list them in a brief bibliography.

### Topic 1: Black holes

Read sections 6.5 and 6.6 of the text book. Then spend at least 2 hours researching black holes and taking notes using internet resources or books or magazine articles. Googling “what is a black hole?” will get you some good leads. Among the things I thought looked pretty good are: Ted Bunn’s black hole FAQ, the YouTube video titled “Travel inside a black hole,” and the HubbleSite on black holes. There are also many links at <http://www.astronomy.ohio-state.edu~dhw/A142>.

Your essay should have two parts, “Facts” and “Reactions.”

“Facts” should address the questions: What is a black hole? How do black holes form? Why do astronomers think that black holes exist?

“Reactions” should address the questions: Of the things that you learned about black holes in your research, what surprised you the most and why? In the culture at large, why have black holes become objects of popular fascination and powerful cultural metaphors?

**See other side for Topics 2 and 3**

## Topic 2: The Sloan Digital Sky Survey

We have talked some in class about the Sloan Digital Sky Survey and its maps of the universe. The SDSS has had a broad impact in many areas of astronomy and cosmology.

To learn more about the SDSS, start by visiting the project's home pages [www.sdss.org](http://www.sdss.org) and [www.sdss3.org](http://www.sdss3.org).

Then read the summary of science highlights from SDSS-I and II at [www.sdss.org/signature.html](http://www.sdss.org/signature.html).

Many of the survey's most interesting science results were reported in press releases, which are collected at the web pages

[www.sdss.org/news](http://www.sdss.org/news) and [www.sdss3.org/press](http://www.sdss3.org/press).

Read at least eight of these press releases (they're short). Then pick three topics, each covered by one or more of the press releases (sometimes there are multiple press releases on a single theme, such as dwarf satellites of the Milky Way).

For each of these three topics, write a summary of what the SDSS discovered, how it did so, and why the discovery is scientifically interesting. Conclude with a paragraph or two about what you found most surprising and/or interesting about completing this assignment.

In a bibliography, list the eight press releases that you read (titles are sufficient).

## Topic 3: Galaxies

This topic is more “participatory” than the other two.

Start by looking through images from the SDSS collected at [www.sdss.org/iotw/archive.html](http://www.sdss.org/iotw/archive.html) and more SDSS images of galaxies at <http://cosmo.nyu.edu/hogg/rc3>.

(Click on individual images to get larger views.) Galaxies are quite varied, so you should look at least 40 of them to get a sense of the variety. The galaxies in these images are all relatively nearby, so the images show a fair amount of detail. If you want to see more SDSS images (of galaxies and other kinds of objects) try following some of the other links at [www.sdss.org/gallery](http://www.sdss.org/gallery).

Next go to

[www.galaxyzoo.org](http://www.galaxyzoo.org),

a web site that allows you to classify galaxies from the SDSS and from Hubble Space Telescope. These classifications, along with those from tens of thousands of other volunteers, become part of a database that has already been used for many scientific investigations.

To understand the background of GalaxyZoo, start by reading the “Story” link at the top of the page and the dozen or so most recent entries on the blog (under the “Science” link).

Then create a user id and password and start classifying galaxies. Classify at least 100 galaxies, so that you get a feel for the variety of galaxies and images and for some of the challenges that arise in classification.

Finally, write an essay describing your experience in looking at and classifying galaxy images. What did you learn by doing this? What things did you notice about galaxies? What surprised you?