

Science and Technology in Everyday Life
Hope College, GEMS 151
Spring 2017

Time/Place: Lectures: MWF 2:00 PM -2:50 PM in VanderWerf 104. (Krupczak)
Laboratories: Tuesday 12:00 PM - 2:50 PM in VanZoren 134. (Krupczak)
Tuesday 3:00 PM - 5:50 PM in VanZoren 134. (Krupczak)

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Course Description:

The course attempts to explain the underlying principles behind the technology and the processes of engineering. The class surveys a broad range of technology including: cellphones, computers, ultrasound, microwave ovens, and the automobile. Consumer products serve as a means of illustrating application of scientific knowledge through engineering. The course seeks to remove some of the mystery surrounding the technology which defines everyday life. We live in a complex and interconnected world created through modern technology. Too often this technology seems as enigmatic as magic. We will identify some key concepts from science and engineering that are applied frequently in modern technology, and work to obtain an understanding of these principles. The course is intended for the general education of liberal arts students who are not majoring in science or engineering.

Any course seeking to address a topic as broad as "science and technology" must be selective in the material covered. As a consequence, many areas of interest will have to be omitted. To compensate for the selective nature of the topics, we will try to develop an ability to become self-educating in technological issues. Science and technology are rapidly changing fields. Even the most exhaustive examination of the topic is at best a snapshot. The capability of independent learning is then an important product of this course which will allow the student to maintain a working knowledge of familiar technology as these fields evolve in the future.

Required

Textbooks: -David Macaulay, *The NEW Way Things Work*, Houghton Mifflin Co, Boston, (1998). ISBN 0-395-93847-3
-Other handouts and readings will be distributed by the instructor
- 3 ring binder is recommended for holding handouts

Grading:	Short Papers	25%
	Final Paper	15%
	Quizzes	20%
	Class Participation & Homework	10%
	<u>Laboratories</u>	<u>30%</u>
		100%

Short Papers:

Three short papers of 3 to 5 pages will be assigned during the semester. The purpose of these papers is to explore issues relating to the use of science and technology in everyday life and to develop your ability to understand and to critically examine scientific and technical information. Papers must be typed.

Final Paper/Project:

A major goal of the course is to give you the ability to learn about science and technology on your own. There are so many different types of technological devices in our world that we cannot hope to cover even a fraction of them in class. For the final paper each student will select a topic in science and technology that has not been discussed in class but may be related to topics covered. You will research the topic and write a paper that discusses the technology, its historical development, and the scientific principles upon which it is based. This paper will be 8 to 10 typed pages in length. A project option may be available in place of a final paper. Details will be provided later in the semester. The final paper/ project takes the place of the final exam and will be due at the end of the finals week.

Quizzes:

We will have in-class quizzes approximately every two weeks. The dates of quizzes will be announced ahead of time. The purpose of the quizzes is to reinforce your understanding of the subject matter of the course.

Class Participation and Homework:

Students are expected to attend every class. On occasion we will have in-class "hands-on" activities. These will usually be accompanied by a short question sheet. Students are expected to complete these activities as directed during class. Completion of these in-class activities will be part of the class participation grade. Homework will be assigned at various times throughout the semester. Homework must be completed by the due date specified.

Laboratories:

This class includes a laboratory. Since the laboratories involve a significant amount of work they count for 30 % of the course grade. You should be registered for one or the other laboratory section. You will need to bring your textbook and something with which to write. You must go to the laboratory for which you are registered each week for the duration of the course. Please try to avoid missing labs. Due to the equipment set up, make up labs are difficult to arrange. If you must miss lab please contact the instructor ahead of time to attempt to schedule a make up

Most laboratories will have a write-up involving a series of questions to be answered. Unless otherwise indicated, these laboratory write-ups are due at the beginning of the next laboratory period. Some information from the laboratories may appear on the quizzes.

Attendance/Checking Email:

Class attendance is expected. Anyone who misses a class for any reason is responsible for finding out the about any assignments or announcements. Please check your Hope College (you@hope.edu) daily for any important course news.

Standards:

- All work must be done on standard 8 ½ x 11 inch paper.
- Paper torn from a spiral notebook is not acceptable. (This paper causes problems when trying to sort)
- Assignments requiring several pages must be stapled in the upper left hand corner.
- Names should be written neatly so they are legible
- Up to 10% of the grade on any assignment may be based on the professional appearance of the work submitted. College-level work should not look like it came from the trash bin of a middle school 😊

All work is expected to be neat and professional in appearance.

I do not expect you to devote an inordinate amount of effort to the appearance of the work. However, points may be deducted from sloppy and carelessly prepared assignments.

AMERICANS WITH DISABILITIES ACT: Any student whose disability falls within ADA guidelines should inform the instructor at the beginning of the semester of any special accommodations or equipment needs necessary to complete the requirements for this course. Students must register documentation with the Office of Disability Services and/or Academic Support Center. If you have questions, call Student Development at extension 7800

Course Evaluation: Hope College expects all students to assess each course in an effort to continuously improve student learning. At the end of the semester, you will be asked to assess how well this course met its stated goals. Your responses will be kept anonymous, but I will take the collective results seriously in thinking about how to provide Hope students the best possible education. Your responses matter. You are urged to participate in this important process.

Late Policy: Late work is accepted but I do not make any promises about when or if it will be graded.

Science and Technology of Everyday Life
Hope College, GEMS 151, Spring 2017

No.	Day	Date	Topics	Reading Due: Macaulay
<i>The Automobile</i>				
1	Mon	1/9	Introduction - Engine Overview	
2	Wed	1/11	Automobile Engine - 4 Stroke cycle	pg 156-7, 48-50
3	Fri	1/13	4 Stroke cycle details	pg 156-7, 48-50
	Lab	T 1/12	No Lab	
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4	Mon	1/16	Engine Support Systems: Fuel & Air, Exhaust	pg 140-1, 157
5	Wed	1/18	Engine Support Systems: Lubrication, Cooling	pg 88, 152-4, 125, 73, 288-98
6	Fri	1/20	Engine Support Systems: Ignition & Starting	pg 88, 152-4, 125, 73, 288-98
	Lab	T, 1/17	Automobile 1	
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7	Mon	1/23	Powertrain	pg 36-7, 40-1, 45, 84-5, 306-9
8	Wed	1/25	Brake System	pg 82-3,86, 120-1, 128, 127,
9	Fri	1/27	Steering, Suspension	pg 43, 78-81,129
	Lab	T, 1/24	Automobile 2	
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10	Mon	1/30	Car body	no Macaulay reading
11	Wed	2/1	Hybrid Cars, Electric Vehicles	no Macaulay reading
<i>Electrical and Magnetic Devices</i>				
12	Fri	2/3	Photocopier, Static Electricity	pg 255-63, 386
	Lab	T, 1/31	Electricity	
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12	Mon	2/6	Current Electricity, Batteries	pg 266-71, 386
13	Wed	2/8	Magnets and Magnetism	pg 274-7, 386-7
14	Fri	2/10	Electricity Generation	pg 33-5, 158-9, 284-5
	Lab	T, 2/7	Magnetism	
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	Mon	2/13	No Class - Winter Recess	
15	Wed	2/15	Electricity Generation, Power Plants	pg 33-5, 158-9, 284-5
16	Fri	2/17	Electric Heaters, Paper 1 Due	pg 150-1
	Lab	T, 2/14	No Lab - Winter Recess	
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17	Mon	2/20	Electric Motors,	pg 280-1, 387
18	Wed	2/22	Light Sources	pg 180-3
19	Fri	2/24	Light Sources, Laser	pg 194-6
	Lab	T, 2/21	Electric Motor	
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20	Mon	2/27	Home Appliances 1	pg 46, 130, 136, 150, 280
21	Wed	3/1	Home Appliances 2	pg 46, 130, 136, 150, 280
22	Fri	3/3	Sound	pg 218-25
	Lab	T, 2/28	Appliances	

Science and Technology of Everyday Life
Hope College, GEMS 151, Spring 2017

<u><i>Sound, Video & Telecommunications</i></u>				
23	Mon	3/6	Microphone, Speaker	pg 228-9
24	Wed	3/8	Telephone	pg 236-7, 384
25	Fri	3/10	Amplifier	pg 226-7
	Lab	3/7	Radio	
25	Mon	3/13	Radio / WiFi Broadcasting	pg 238-41, 385
26	Wed	3/15	Cell phone, Paper 2 Due	pg 236-7, 322, 332, 350-2
	Fri	3/17	No Class Spring Break	
	Lab	T, 3/14	Amplifier 1	
			Spring Break	
27	Mon	3/27	Cell phone 2	
28	Wed	3/29	TV-Video 1	pg 182-3, 242-3, 246-7, 361, 385
29	Fri	3/31	TV-Video 2	pg 182-3, 242-3, 246-7, 361, 385
	Lab	T, 3/28	Amplifier 2	
30	Mon	4/3	Recording	pg 230-33, 244-5
31	Wed	4/5	Digital Recording 1	pg 330-7
32	Fri	4/7	Digital Recording 2	pg 330-7
	Lab	T, 4/4	Speaker	
<u><i>Computers</i></u>				
33	Mon	4/10	Computer 1	pg 310-26, 388
34	Wed	4/12	Computer 2 - Paper 3 Due	pg 327-337
	Fri	4/14	No class	pg 338-53, 366-73
	Lab	T, 4/11	Music Keyboard 1	
	Mon	4/17	Easter Monday - No class	pg 218-225
35	Wed	4/19	Music Keyboard Circuit Explanation	pg 296-299, 304-5, 388
<u><i>Miscellaneous</i></u>				
36	Fri	4/21	Medical Imaging: Xray, MRI, Ultrasound	pg 296-299, 304-5, 388
	Lab	T, 4/18	Music Keyboard 1	
37	Mon	4/24	Refrigeration	pg 152-3
38	Wed	4/26	Microwave	pg 144
39	Fri	4/28	Flight, Quiz	pg 106-113, 378
	Lab	T, 4/25	Final Lab	
	Fri	5/5	Final Paper Due 5 pm	Final Paper Due - last day of finals

Other homework assignments to be included during the course of the semester
Quizzes to be announced

Science and Technology of Everyday Life
Hope College, GEMS 151
Short Paper #1 (3-5 Pages)
Topic Due Friday 2/3
References Due Friday 2/10
Completed Paper Wed 2/17

Option 1: Explain a problem that you once had with a car.

Option 2: Investigate and answer in some depth a question that you might have about the automobile.

Purpose of this assignment:

Due to the survey nature of the course, there are many questions about the automobile that we have not discussed. This paper provides an opportunity for you to pick a topic from your own experience and interests and pursue it in more detail. The assignment is meant to build on your knowledge learned in class and extend it through your own research.

More Detail about Option 1: A problem you once had with an automobile.

Have you ever experienced a problem with your car? The objective of this option is to select such a problem about which you currently know very little. You will then research and investigate the problem to develop a more thorough and complete understanding of the situation, what broke or when wrong and why the various symptoms that you experienced occurred. Cars are indispensable in our current way of life. We rely on them daily as our primary means of transportation. When a problem occurs, the results can range from a minor inconvenience to a major disruption of our lives. This paper is intended to help you to make sense of something that happened, and give you experience researching car problems should you need to do so in the future.

Some questions to help in writing a paper about option 1.

What happened?

What system was affected? (Engine, Power train, Brakes, Steering, Suspension, Electrical, Body)

What is the function of the system and how did the problems affect the system?

Which component or components were involved?

What is the function of the component and how does it work?

Explain the job or role of the affected components in the overall functioning of the car.

Exactly why did the problem occur?

 What failed, broke, wore out?

 What was done that should not have been?

 What was not done that should have been?

How and why did the problem produce the results that you experienced?

How was the problem resolved? What was replaced, fixed, adjusted? By whom?

What lessons were learned for the future?

Are there any new or recent developments related to your problem?

 Changes made by the car company

 Product recalls

 Innovative developments which would affect such problems in the future?

Knowing what you know from your research does the incident make more sense to you now?

More Detail About Option 2: A topic of interest about the automobile:

You may have questions about the automobile about which you would like to know more. Because of the survey nature of our class, there are many interesting and important issues that we cannot study in detail as a class. This paper provides a way to explore a question or topic of particular interest to you. Examples might be:

I would like to know more about hybrid cars.

I have always been curious about the catalytic converter. I would like to understand it better.

What do all of those gauges and lights mean on my dashboard? Which ones shouldn't I ignore?

Are airbags a safety hazard or not?

What should I look for in buying a used car?

What kind of maintenance and simple repairs should I be doing on my car myself?

In writing a paper on option 2, it is important to emphasize the technical or scientific aspects to the question. Describe any relevant systems and the major components and their function.

What is Due for the Topic?

For the Topic Assignment please prepare a 100-300 word (1/4 page) typed summary of the intended subject of your paper. Indicate whether you are doing option 1 or option 2. Your topic summary can address one or more of the following - Describe the problem that you had or the question you would like to investigate. Describe why you are interested in that particular topic. Describe what you might already know about the topic and some questions that you would like to answer or investigate.

Research and References

At least 5 references are required, 2 must be NON-Internet. In other words, not all of the research can be done on the web.

Possible Sources

"Experts" such as mechanics, and other knowledgeable individuals such as family members or friends. Include names and dates consulted in your list of references.

Several Automotive Mechanics books on reserve for our class in VanWylen.

Papers must include a list of references (bibliography). Reference information must be complete including page numbers. Web sources must be properly cited. Any experts consulted should be included in your list of references.

Notes and Recommendations

Things that I am looking for are well-researched and well-written answers. My objective is to see that you researched the topic to some depth and display an understanding of the issues. I would like to see that you combined information from a variety of sources. It should be apparent that you really investigated the topic and invested some effort into the assignment.

The explanations should be at a level that can be understood by a non-technical person.

Research will be a major part of the work for this paper. It will take more time than you think.

Including drawings, photos, diagrams, or other visual aids is highly recommended. Copying from websources is acceptable. Cite the source of all copied figures.

I would be happy to discuss possible topics or answer questions.

Science and Technology in Everyday Life (GEMS 151)
Paper Assignment: The Savvy Consumer
(Short Paper 2 Part 1)

There are 3 parts which will eventually combine into the paper)

Part 1 DUE Friday 3/31/17

The context for this exercise will be the hypothetical purchase of a consumer product. You will investigate how a particular product works and what to look for in buying that product.

Pick a product that you plan (in theory) to purchase. **The product must some type of electrical appliance from the list below.**

Part 1: How it Works –Functional Analysis

Analyze how the device works and create a Functional Analysis Diagram of the device. This should be similar to what was done in lab.

List of Potential Topics

- Think of something you would really want to buy.
- The product must be based on an electric motor or an electric heater or both.
- Cannot use the same devices we used in lab.

Dishwasher	Sewing Machine	Food Processor
Washing Machine	Electric Shaver	Shredder
Electric Clothes Dryer	Space Heater	Rice cooker
Blender	Blow Dryer	Crock pot/Slow Cooker
Mixer	Coffee maker	Other Small Appliance (with approval – but NOT microwave ovens)
Toaster	Clothes Iron	Air conditioner
Vacuum cleaner	Hair Curler / Straightener	Dehumidifier
Power Drill	Electric Can opener	Freezer
Other Power Tool (saw, etc.)	Electric pencil sharpener	
Air purifier	Espresso maker	

Functional Analysis

- Create a functional analysis diagram of the device.
(Remember you know the basics already: motors, heaters, and/or refrigeration)
- Use the detailed instructions on moodle to help you get through the process step-by-step.
- Information on these devices is available on moodle and your own internet searching.
- **Please do not just google search: functional analysis of X. You will get all kinds of crazy things and if you just copy one of these it will be wrong and a waste of time.** Think it through for yourself.
- Recommended that you use a large sheet of paper and postit notes as was done in lab. You can use the lab room. The materials are in the room. Door code is 98025. The lab should be free all day Wednesday and Thursday.
- Turn in your large sheet (with postit notes taped down) in class on Friday 3/31.
- Turn in your list of any sources used.

Science and Technology in Everyday Life (GEMS 151)

Paper Assignment: The Savvy Consumer (Short Paper 2 Part 2) Part will eventually combine into the paper

Part 2A DUE Monday 4/10

Responses should be based on device selected in Part 1
Save everything since you will need to merge all parts into the paper when completed.
Please type and turn in hardcopy in class.

1. Problem Description (10 – 100 words)

Why do you need this device? What problem does it solve for you? Express the problem in Verb- Noun form. For example: “I need this to VERB – NOUN.” If I were giving you the money to buy it, how would you convince me that you need it? Note: this does not need to be a long drawn out explanation.

2. Use scenario (100-200 words)

Describe how you plan to use the device. What is typical use scenario? What, when, where, why?

3. Issues of Importance (100-300 words)

What is important to you when you are using this device? What issues arise that are related to your use of this device?

4. Requirements

Develop a list of at least 15 requirements. It can be difficult to reach 15 so it will take some thinking. Note this is just your wish list of requirements nothing has to actually meet all of them at this point. These should each be fairly short and succinct. Examples: Inexpensive, lasts a long time, can be dropped without breaking, quiet, small size. If needed, use the handout on product design requirements to help you think of features that are important to you.

5 Possible Choices

Shop online to find 5 possible products that you could purchase.

- For each one include the company name, model number, and price.
- Cut and paste the link so you can find it again.
- For each choice describe the main functions, features, and characteristics. This should be 50-100 words for each (at least). Do not just cut and paste the description, summarize in your own words. Imagine you are describing the option to a friend, how would you describe the most important features and what you like or don't like about this option? 50 – 100 words is not a lot so this should not be that difficult.

Time needed: I expect that this should take 2-3 hours to complete

Science and Technology in Everyday Life (GEMS 151)

Paper Assignment: The Savvy Consumer Short Paper 2 Part 3 (final part)

DUE Friday 4/21

Making a purchase choice



Decision Matrix

- Create a Decision Matrix for your purchase.
- Follow the 9 Steps in the Decision Matrix Handout as was done in class in the example of the coffeemaker and the hairdryer
- For convenience, a blank decision matrix spreadsheet template is available on moodle.
- **Warning – this can be time consuming do not wait until the last minute to complete.**

Analysis

Make your purchase choice. Use your decision matrix results to explain or defend your choice. In defending your choice consider some of the following questions. What criteria did you use? Why did you choose the weights that you did? What were the results? What seems to be your best and worst choice? Are you content with this result?

(Expected length about 1000 words or more. This is 2 pages single spaced 12 font)

Turn In:

Hard copy of your completed decision matrix.

Hard copy of typed analysis.

Science and Technology in Everyday Life (GEMS 151-01)
Paper 3 (3-5 Pages)

Technology: Change, Impacts and Controversies

Topic due Wed 4/10/13
5 References due Wed 4/17/13
Paper due Wed 4/24/13

Two Options

This purpose of paper is to examine scientific and technological devices that have changed a familiar aspect of everyday life. To do so we will have to expand our thinking about technology to include related non-technical issues. The emphasis on the paper will be your own analysis and opinion rather than how the technology works.

Option 1 Impacts of Technology

Consider **ONE** technological device that has become available or has grown and changed significantly in your lifetime. The particular technology is up to you but the main criteria is that it must be a rapidly changing technology and you can remember a time when the technology was significantly different from what it is today.

Possible examples:

- Cell phones.
- Various types of digital music (iPod, iTunes.)
- Digital cameras.
- Wi-Fi.
- Global Positioning Systems (GPS)
- Automobile navigation systems based on GPS.
- DVD
- Video Games
- HDTV
- Other?

Write a paper of 3-5 pages that addresses the following questions: What was life like before this device? What was life like after? What impact has this technology or device had on daily life? What factors, forces, or desires caused this change? Is this good, bad, both, neither?

Some specific questions to address:

What service or convenience does this technology provide? In other words, what is it's function?

How has the technology changed in your own lifetime?

What is new, different, improved compared to earlier devices? Or what features or conveniences have caused the new technology to grow?

Why do we need it?

What are the benefits of this technology to the end user?

Other possible questions to help you write your paper might be:

Has anything desirable been lost?

Are there any positive changes?

Are there any negative changes?

Were any of these changes expected or predicted?

What are some unexpected or unanticipated changes caused by this technology?

What are some new problems caused by this new technology?

Were any of these changes unanticipated?

Can the negative effects be reduced or eliminated?

What aspects of daily life have been affected?

Has this technology affected all aspects of society the same way?

Who promoted this technology? Who opposed it?

Have any particular groups benefited more than the rest of society?

Is this progress? Has the quality of life been improved? Can you argue both yes and no?

Option 2: Technology Benefits and Risks

Technological advances solve problems but also creating new problems.

Choose one of the following technological controversies:

Possible options

1. Asian labor conditions where most electronic devices are manufactured
2. Labor conditions for mining of rare earth minerals critical to modern technology in less developed countries. (conflict minerals)
3. Identity theft
4. Hacking of celebrity cellphones, email.
5. Use of cellphone data by police authorized and unauthorized.
6. GPS tracking devices
7. Allegations of cancer caused by use of cellphones
8. Google, Facebook, loss of privacy to corporations
9. Cellphones and driving
10. High Frequency Computerized Stock Trading and Flash Crashes
11. Other?

Write a paper that addressing the following points:

1. Why is the issue controversial? What is the problem? What are the benefits? What are the risks?
2. What are the critical technical and scientific aspects of the issue if any? Explain any critical underlying technical aspects of the problem if this helps to clarify the nature of the problem. Use drawings or figures as appropriate. Be sure to identify the source of any photocopied figures.
3. What are the social, economic, ethical, and cultural effects and implications?
4. In your opinion, what does the issue say about the relationship between humans and technology? Do we control it? Does it control us? Are there economic or social forces at work that are not within our ability to control? What do you think? Which side do you favor and why?

Notes for Both Options

-Paper should use 10 – 12 point type, standard 1-1.25-inch margins, double-spaced.

-References must be written in the standard format as specified in *The St. Martin's Handbook*.

Web site references MUST follow the APA guidelines for citing internet sources \

What I am looking for:

-Use the full 5 pages; go over 5 pages if you want. Consider 3 pages a bare minimum to get a C.

-A good selection of high-quality and particularly appropriate references (works consulted but not necessarily quoted). Part of the paper grade will be based on the quality and diversity of the references used. As in the other papers, a significant portion of the work in writing the paper is finding good references.

-I will look for evidence that you have really thought about the topic and absorbed the information in the references.

-This is NOT a research paper. **The paper should be based on your own thoughts and ideas as informed by your use of information gained from references.** These are difficult issues. There are no right and wrong answers, but it is possible to have an informed and thoughtful opinion. **In your paper you should argue persuasively and defend your opinions.** You may cite outside references in support of your positions.