3-1-2016

24. Writing Process: From Audience to Rough Draft

David McMurray

Sexy Technical Communication Home

Writing Process

The *writing process* takes you from the very beginning of a writing project—finding topics and analyzing audience and purpose—all the way to the end—writing and revising the rough draft. The following chapters focus on some of the key phases of that process:

Strategies for team-writing

Audience Analysis

Brainstorming and invention

Narrowing

Outlining

Note-taking

Libraries, Documentation, Cross-Referencing

Strategies for Peer-Reviewing

Power-Revision Techniques

Sexy Technical Communication Home

Find Report Topics

As a writer in a technical writing course, you may need some strategies for finding topics for writing projects, which are provided in this section.

By definition, technical-writing courses are opportunities to focus on practical uses of your

writing skills. In the ideal technical-writing course, you would have a work-related writing project every two to three weeks: for example, instructions for that pesky fax machine down the hall or recommendations on home alarm systems. However, technical-writing courses are also great opportunities for exploring science and technology: latest advances in nanotechnology, latest theories about the origin of the universe, latest methods for hydroponic gardening. If your instructor encourages you to find your own topics, take a look at the following suggestions.

Cutting-Edge Technologies *How ambitious and daring are you? The link below takes you to some amazing, crazy inventions and discoveries.*
Gizmag.com clippings

Volunteer Opportunities *Find a service-learning opportunity that involves some writing!*
Read about Service Learning. In particular, take a look at the volunteer opportunities

Topic Ideas for Technical-Writing Courses
Peruse these topics—see if any possibilities for projects come to mind.

Wormholes	Superstrings	3D printing	High-definition TV
Anthropocene era	Unmanned avionics (drones)	Green roofs	WiFi
Global warming	Deforestation	Acid rain	Ozone depletion
Rain forests	Continental drift	Greenhouse effect	Endangered species
Industrial waste disposal	Mount St. Helens eruption	Solar energy devices	Nuclear power
Plate tectonics	Solar automobiles	Petroleum-based energy	Thermal power
Wind energy	Freon	Mass transportation	Nuclear fusion
Microwave technologies	Bomb detection methods	High-tech weaponry	Advances in automotives
Xeriscaping	Soil analysis	Hybridization techniques	Hydroponics
Recycling	Drip irrigation	Alternative agriculture	Desalination methods
Genetic engineering	World Wide Web	Computer video	Multimedia
Computer memory	Computer animation	Fiber optics	Computer audio
Virtual reality	Artificial intelligence	Telecomputing	Telecommuting
Advanced compact disks	Cellular telephones	Personal digital assistants	Videoconferencing

Digital interactive TV	UFOs	Satellite TV	Object-oriented programming
Digital imaging	Cable TV	Computer-aided education	Neural networks
Teleconferencing	Advances in telephony	CD-ROM technology	Computer graphics
Distance education	Computer crime	DVD technology	Robotics
Tech Prep	Virtual classroom	Expert systems	Devices for diabetics
Advanced prostheses	Artificial heart	Diabetes	Artificial limbs
Kidney transplants	Alzheimer's disease	Hypoglycemia	AIDS
Ebola	Encephalitis	Knee/hip replacements	Carcinogens
Hyperkinetic behavior	Caffeine	Saccharine	Psychosomatic disorders
Nicotine	Genetic engineering	Vitamin therapies	Magnetic resonance imaging
Recombinant DNA	Gulf War Syndrome	Ultrasound	Sickle cell anemia
Agent Orange	Inflation	Recession	Capital-punishment methods
Dream research	Balanced budget	Abortion methods	Handwriting analysis
Dyslexia	Biorhythms	Pheromones	Wellness programs
Acupuncture	Big Bang Theory	Life on Mars	Saturn expedition
Extraterrestrial intelligence	Gout	Supernova	Mars expedition
Halley's Comet	Universe	Space shuttles	Uranus expedition
Black holes	The Moon	Volcanoes	Sink holes
Venus	Tornadoes	Hurricanes	Earthquakes
Monsoons	Droughts	Whales	Boa constrictors
Rattlesnakes	Sharks	Geckoes	Panda bears
Black widows	Iguanas	Wolves	Eagles
Dolphins	Scorpions	Coyotes	Dinosaurs
Influenza	Panic attacks	Heart attacks	Breast cancer
Lung cancer	Bioengineered foods	Migraines	Nanotechnology

Ideas for Audiences *See if the following list of audiences brings to mind technical-writing projects.*		
City council members	Parent-teacher association	Downtown renovation commission
Neighborhood association	City transportation board	Rural utilities cooperative

Recycling special interest group	Student parking action group	Student housing board
City mass transportation agency	Business secretary association	Pet owners society
Save-our-trees action group	Citizens antipornography league	City beautification commission
Alternative energy-resource investors	Friends of sidewalk artists	Housing for the homeless society
Computer animators society	Alternative-transportation action group	College solar-automobile club
High-school science teachers association	City busriders support group	Drug-rehab center board
Citizens-against-crime league	Computer-game design society	Your local government representative
City mayor	County commissioners	Home-brewers and microbrewers club
Organic foods cooperative	Student housing cooperative	Local wine makers society
	Student services director	

Academic and Workplace-Oriented Majors

Consider interesting courses or projects related to your major or any of the following.

Accounting	Air conditioning technology	Aerospace technology	Refrigeration technology
Astronomy	Automotive technology	Biology	Biotechnology
Engineering	Chemistry	Child development	Computer science
Culinary arts	Diagnostic medical imaging	Electronics	Building construction technology
Emergency medical service technology	Engineering design graphics	Information records management	Physical fitness technology
Geomatics (land surveying technology)	Fire protection technology	Medical lab technology	Meteorology
Molecular genetics	Urban studies	Engineering	Marine biology
Molecular biology	Biochemistry	Petroleum engineering	Geosystems engineering
Neurobiology	Mechanical engineering	Electrical engineering	Biomedical engineering
Military science	Civil engineering	Chemical engineering	Nursing
Occupational therapy	Office systems technology	Pharmacy technology	Photography

Geology	Physics	Printing technology	Quality assurance
Surgical technology	Technical communication	Welding technology	X-ray operations

Interesting Magazines and Journals *Go to your local library or newsstand and flip through some of the following.*		
Flying	*Mother Earth News Magazine*	*Popular Photography*
Issues in Medical Ethics	*Wood Magazine*	*4 Wheel & Off Road magazine*
Air & Space Magazine	*Audio Magazine*	*Smithsonian*
Home Improver Magazine	*Family Business Magazine*	*PC Magazine*
Byte Magazine	*Family*	*Handyman Magazine*
Anthropological Linguistics	*Nature*	*Astronomy Magazine*
Scientific American	*National Geographic*	*Cogeneration*
Energy Research News	*Lab Animal*	*Molecular Vision*
Neuron	*Petroleum Equipment & Technology*	*BBC News: Science and Technology*
Electronic Journal of Biotechnology	*American Naturalist*	*Nuclear Plant Journal*
Garden and Forest	*Water, Air, and Soil Pollution*	*Forest Ecology and Management*
Weed Research	*Wetlands Ecology and Management*	*Conscious Choice: The Journal of Ecology & Natural Living*
Issues in Science and Technology	*Technology & Culture*	*Electric Vehicle World*
Discover Magazine	*Distant Star*	*GEO Magazine*
Gene Therapy Weekly	*Home Power Magazine*	*Physics World*
Robot Science & Technology	*UFO Digest*	*Sea Technology*
UFO Magazine	*NanoTechnology Magazine*	*Popular Mechanics*
Popular Science	*Technology Review*	*Cyberspace Today*
Wired	*Space Business International*	*Amateur Astronomy Magazine*
Sky & Telescope	*CNN: Sci-Tech*	*Brain & Mind*

Journal of Prisoners on Prisons	*Electronic House Online*	*Home Energy*
Popular Home Automation	*Hazardous Materials Management Magazine*	*Professional Boatbuilder Magazine*
Practical Hydroponics & Greenhouses	*Progressive Farmer Today*	*Potato Grower*
Pest Control Technology (PCT)	*Goat Farmer Magazine*	*Disaster Recovery Journal*
Upholster Magazine	*CleanRooms*	*Worm Digest*
Recycling Today Magazine	*American Waste Digest*	*American Small Farm Magazine*
Pacific Fishing	*Urban Transportation Monitor*	*Advanced Rescue Technology*
Pit and Quarry Magazine	*Corrections Technology & Management Magazine*	*Wireless Access Technologies*
Journal of Emergency Medical Services		

Interesting Websites
Browse some these websites for ideas.

Artificial Intelligence and Robotics. Provided by the Georgia Tech Mobile Robot Lab: www.cc.gatech.edu/ai/robot-lab/mrl-jump-points.html	Humanoid Project. From Waseda University (Japan), its project to develop a humanoid robot: www.shirai.info.waseda.ac.jp/humanoid
Robotics. From the Seattle Robotics Society: www.seattlerobotics.org/websites.html	Virtual Reality Society. News, software, links, introductory information about virtual reality: www.vrs.org.uk
Solar Car Page. Lots of information about and links to solar-powered cars: www-lips.ece.utexas.edu/~delayman/solar.html	National UFO Reporting Center. For the collection and distribution of objective UFO data: nwlink.com/~ufocntr/index.html
Introduction to Artificial Intelligence. Developed by Tim Dunn, Adam Dyess, and Bil Snitzer: tqd.advanced.org/2705	Fractalzone. Provided by Philippe Wautelet a good introduction to fractals and links to related sites: fractalzone.home.ml.org
Virtual Worlds Project. MIT Artificial Intelligence Laboratory's advanced distributed interactive simulation (DIS) systems for science, engineering, medicine, commerce, and industry: www.ai.mit.edu/projects/vworlds/vworlds.html	Human Powered Transportation Committee From the American Society of Civil Engineers, a group dedicated to incorporating human-powered transportatic (walking and bicycling) into transportation systems: ourworld.compuserve.com/homepages/kbarrett/asce-hpt.htm

Solar Buildings Program. From the Department of Energy's Energy Efficiency and Renewable Energy Network: www.eren.doe.gov/solarbuildings	U.S. Department of Energy's Wind Energy Program. Applications, innovations, links to related sites: www.eren.doe.gov/wind
Photovoltaic Power Resource Site. Information on photovoltaic (converting solar to electrical energy) history, resources, applications, projects, and employment: www.pvpower.com	American Association for Wind Engineering An organization for promoting the research and professional practice of as well as for distributing information on wind engineering liberty.uc.wlu.edu/~aawe
Nova Structure. Project at the Academy for the Advancement of Science and Technology to design an energy-efficient house: www.bergen.gov/ATC/nova_structure2.html	U.S. Department of Energy's Biomass Power Program. About biomass power, current biopower projects, technical reports general explanations for average citizens: www.eren.doe.gov/biopower
U.S. Fusion Energy Sciences Program. A knowledge base for an economically and environmentally attractive fusion energy source: wwwofe.er.doe.gov	Cold Fusion Times. Journal on the scientific aspects of loading isotopic fuels into materials as well as related topics: world.std.com/~mica/cft.html
Biofuels Information Center. Provided by the National Renewable Energy Laboratory: www.biofuels.doe.gov	Scientists for Global Responsibility. Web site promoting socially responsible and ethical uses of science and technology: www.gn.apc.org/sgr
Food for Our Future. Provides understandable explanations of the benefits that biotechnology could bring to our food supply and addresses people's concerns about the new technology: www.foodfuture.org.uk/index2.htm	Ethanol Vehicle Challenge. From the College of Engineering, Center for Environmental Research and Technology at University of California, Riverside: helium.ucr.edu/~teamcert/ethanol
Greener Cars. Toyota's website presenting its efforts to make automobiles "greener": www.toyota.co.jp/e/green	Veggie Van. A small motorhome powered by a clean-burning fuel made from used an new vegetable oil. www.veggievan.org/Veggie Van
DOE Transportation Technologies. From the DOE Office of Transportation Technologies, in the Energy Efficiency and Renewable Energy Office of the Department of Energy: www.ott.doe.gov	What Is Cybernetics? From the Departmer of Industrial Technology, Bradford Universit UK: www.brad.ac.uk/acad/cybernet/whatisit/ cyberwhat.html
Hybrid Electric Vehicle Program. NREL program (Department of Energy) information about hybrid electric vehicles: www.hev.doe.gov	Ralph C. Merkle's Cryonics Webpage. Discussion and links concerning cryonics: merkle.com/merkleDir/cryo.html
Biomedical Visualization. University of Illinois at Chicago website:	Artificial Heart Program. From the Universit of Pittsburgh, its research and clinical

www.bvis.uic.edu/Biomedical Visualization	program for the treatment of end-stage heart failure: info.pitt.edu/~gwb1/UPMC
American Cryonics Society. Preserving the whole body, head, or brain, of persons recently declared legally dead, in the hope of revival at some time in the future: www.jps.net/cryonics	The Visible Human Project. MRI cross-sections of the human body with explanations: ww.nlm.nih.gov/research/visible/visible_human.html
Manufacturing at the molecular level! Information and links to articles and websites about nanotechnology provided by Ralph C. Merkle: nano.xerox.com/nano/Nanotechnology	SETI Institute. Search for Extraterrestrial Intelligence Institute, an organization devoted to scientific and educational projects relating to life in the universe: www.seti-inst.edu
International Space Station. NASA's website for this project: station.nasa.gov/core.html	Project Skylab. NASA's Skylab Project: www.ksc.nasa.gov/history/skylab/skylab.html
Superluminal Motion: Fact or Fiction? Possibility of faster-than-the-speed-of-light travel: al.cs.byu.edu/ketav/issue_3.2/Lumin/lumin.html	Physics and Star Trek. Jason W. Hinson's explanations for the "science" in science fiction (especially Star Trek) based on current physics: london.physics.purdue.edu/~hinson/physandtrek/index.html
"Companion Object" Near Hale-Bopp Comet? Links concerning the comet, possible UFOs, cover-ups, and other X-File-ish things: 205.243.132.23/comet-1.html	Time Travel. Possibilities of time travel: freespace.virgin.net/steve.preston/Time.htr
Human Genome Organisation. Human Genome Organisation (HUGO), the international organization with the global initiative to map and sequence the human genome: hugo.gdb.org	DOE Human Genome Program Home Page Department of Energy's website on the human genome project: ww.er.doe.gov/production/ober/hug_top.html
Human Cloning and Genetic Engineering. Provided by Arthur Kerschen of the University of Arizona, discussion and links related to genetic engineering—human cloning, in particular: www.u.arizona.edu/~ahk/cloning/index.html	How to Clone a Human. Also provided by Arthur Kerschen of the University of Arizona ww.u.arizona.edu/~ahk/cloning/human.html

Work Place: Ideas for Technical-Writing Projects *What's going on at work? Are the projects there, just waiting for you? Browse some of these ideas:*
Does the office need a new photocopy machine?
Are you considering a fax machine? a CD writer? a digital camera?
Is the staff expected to use a new software application for which there is no user guide?

Are you and other employees interested in telecommuting (using electronic and computer methods to work at home)?
Is management considering putting all operating procedures and other administrative materials online?
Has your agency been challenged to go "paperless"—to get all files stored and searchable electronically?
Have you been tasked with recommending a personal digital assistant, cell phone, or notebook computer for all employees in your company?

Problems, Problems, Problems . . .
A good source for volunteer projects is Idealist at www.idealist.org, a site run by Action Without Borders, a non-profit foundation. It lists 10,000 Web sites for non-profit organizations, information on volunteering, jobs, and projects.

Inadequate public transportation	Lack of parking	Overflowing land fills
Smog and otherwise dirty air	Crowded streets and highways	Crime, vandalism
Homeless people	Lack of daycare facilities	Unemployment
Lack of low-cost housing	Dwindling water supplies	Expensive electricity
Natural areas threatened by urban development	Lack of parks and recreational facilities	Lack of facilities for the elderly
Rodent infestations	Mosquitoes	Lack of vegetation (trees, shrubbery, etc.)
Projects for nonprofits	Lack of facilities for young people	Expensive water

Sexy Technical Communication Home

Brainstorm Topics for Writing Projects

If you have a topic for your writing project (if not, see topics) , the next step is to think about subtopics related to it. During this stage, the "invention" or "brainstorming" stage, use the following suggestions to explore your writing project topic:

- Let the subject of your writing project itself suggest subtopics; for example:

Subject	Possible topics
The sun	its temperature its composition its unusual phenomenon its relative size
	its physical properties

Ultrasound in medicine	equipment used medical uses advantages

- Use an invention checklist like the following. If you ask yourself the questions listed below, you'll be less apt to overlook important subtopics; and, with use, these questions eventually become almost automatic.

A Checklist of Invention Questions	
Problems or needs	Does your writing project concern itself with a problem or a need?
Solutions and answers	Should your writing project discuss potential solutions or answers to the problems or questions presented in the project?
Historical events and natural phenomena	Does your writing project concern itself with some historical event or natural (or mechanical) phenomenon?
Causes and effects	Should your writing project discuss the causes, effects, or both related to the phenomenon, historical event, or problem you are discussing?
Descriptions	Which aspects of your writing project require description?
Processes	Does your writing project involve processes, procedures, routines, or repetitive events that must be discussed in steps?
Classes	Can the main topic or any subtopic within your writing project be divided into classes or types?
Comparisons to similar or familiar things	Can similar things in your writing project be compared to each other? Can you compare something complex in your writing project to something familiar or common?
Illustrative examples	Will a discussion of examples related to your writing project be effective?
Theoretical background (definitions)	Are there unfamiliar terms in your writing project? Should you include them in your project and define them?
Applications	Can you discuss the applications related to your writing project?
Advantages and benefits	Should you discuss the advantages or benefits related to your subject?
Disadvantages and limitations	Are certain disadvantages, problems, limitations, or drawbacks associated with your subject?
Warnings, cautions, and guidelines	Does your writing project need cautionary or guideline statements?
Economics or financial	Should you discuss cost factors, purchase expenses, maintenance and operation costs, production or output costs, or

considerations	savings?
Importance of the topic	Should you discuss the importance of your subject, why people should concerned about it or interested in it?
Historical background and important names	Is there some important historical background—events and names—that should be discussed in your project?
Future developments	Should your writing project speculate about future developments or possibilities related to the subject?
Social, political, legal, or ethical implications	Does the topic of your writing project raise certain social or ethical questions—as, for example, certain medical technologies do?
Reasons for or against	In your writing project, should you try to convince readers to take certain actions or think a certain way concerning your topic?
Conclusions	Should your writing project draw certain conclusions about what it discusses?
Recommendations	Should your writing project make certain recommendations to its readers?
Alternatives or choices	Should your writing project discuss several alternatives or choices related to your subject matter?
Criteria, requirements	Will your writing project use certain criteria to draw its conclusions or to make its recommendations?
Tests and methods used	Should you have a section on the tests you perform, the methods or theories you use, or the procedures and equipment you use?
Statistical presentations and analyses	Should you include a section that summarizes and analyzes the data you collect in your project?
Legal and administrative demands	Should your writing project discuss which agencies to apply to, which forms to fill out, or which steps to take in order to accomplish the purpose of your project?
Business or professional contexts	Should you describe the specific business or professional situation, for example, a supervisor's orders, that generates the need for your project? (This applies if you invent a writing situation also.)

Here is an excerpt of a brainstorming session in which these questions were used:

Example of a topic list developed with the invention checklist
How does a wind-powered electrical system (WPES) work? what are the steps in its operation? Savings: discuss the

amount of money that can be saved using WPES. Relationship between average windspeeds and electrical output: what happens when there's no wind, only very light breezes? too much wind? Basic parts: rotor, generator, tail assembly, tower Different manufacturers of WPES: how to get a good system and avoid being ripped off. Dimensions, materials, construction of common models of WPES; sensitivity to low wind speeds Historical background on WPES: the time when more WPES were being used, just before rural electrification in the 1930s; who were the first developers? when has interest in WPES reappeared? why? Two general class of wind machines: lift and drag machines Lightning protection of WPES Aerodynamic principles as they apply to WPES Understanding weather patterns and seasonal and geographical factors affecting wind Principles of electricity: circuits, generators, types of current, meanings of terminology Local, state, federal tax credits and research support in wind systems research and WPES purchase by consumers

Sexy Technical Communication Home

Narrow That Report Topic

For a writing project in a technical-writing course, the ideal starting place is a workplace problem requiring some writing as part or all of the solution. With such a project, the audience and problem are there to help you narrow the topic. However, if you begin with a topic, it's harder to narrow. You are likely to end up trying to write a ten-pound textbook on automotive plastics, residential solar energy in the home, or La Niña. Narrow the topic and do some careful research—the result will be a practical, useful document that doesn't go on forever.

Narrowing means selecting a portion of a larger topic: for example, selecting a specific time period, event, place, people, type, component, use or application, cause or effect, and so on. Narrowing also means deciding on the amount of detail to use in discussing those topics.

Note: In the following example of the narrowing process, you may wonder how all those subtopics seem to come to mind so effortlessly. If that's not the way it is for you, try some brainstorming and invention first.

Following the Narrowing Process

Let's walk through a typical narrowing exercise to see how it works. This particular example works "backward" from a topic to a realistic audience and purpose. In a "real world" situation, you'd begin with a workplace situation.

1. Imagine that you want to write something about gardening. You have a backyard vegetable garden that you grow as a hobby, and of course for the vegetables it produces:

   gardening >>
2. What can you do with a topic like gardening? You know you want to focus on vegetable gardening, but that's only a first timid step at narrowing. There are still dozens and dozens of topics related to vegetable gardening:

   gardening >> vegetable gardening
3. What are the possibilities related to vegetable gardening? Obviously, there are topics like planting techniques, pest control, fertilization and irrigation topics, perhaps even special-focus reports on individual vegetables—tomatoes, onions, butter beans, peppers. Among these, you lean more to gardening methods or techniques—such as drip irrigation, raised-bed gardening, organic pest control, and so on:

   gardening >> vegetable gardening >> special gardening techniques
4. Now you are getting somewhere! But you can't write on all those techniques— pick one! Recently, you were reading about how NASA's plans for the human exploration of Mars includes growing food there on the planet—specifically by using hydroponic methods. This sparks your curiosity; it's the right topic for a technical document of some kind:

   gardening >> vegetable gardening >> special gardening techniques >> hydroponic gardening
5. You're all done with narrowing, right? Sorry, you're barely half-way there. Hydroponics, the science and craft of growing plants without soil, is a big topic in its own right. What specifically interests you about hydroponics: Interested in setting up a hydroponics system in your garage? Curious whether the claims about hydroponically grown foods are true? Wondering what it takes to run a hydroponics system? Interested in finding a commercially available hydroponic system that meets your needs and price range? Yes —something about practical realities of hydroponics! Your real interest here is the feasibility of hydroponic gardening, recommendations, or both:

   gardening >> vegetable gardening >> special gardening techniques >> hydroponic gardening >> feasibility/recommendations relating to hydroponic gardening
6. Now you have a choice: (a) focus on the feasibility of hydroponics or (b) focus on commercially available systems to determine which is best and which will fit in your garage. At this stage, you are not ready to pick a system; instead, you must convince yourself that the whole concept is practical. Therefore, let's focus on the general

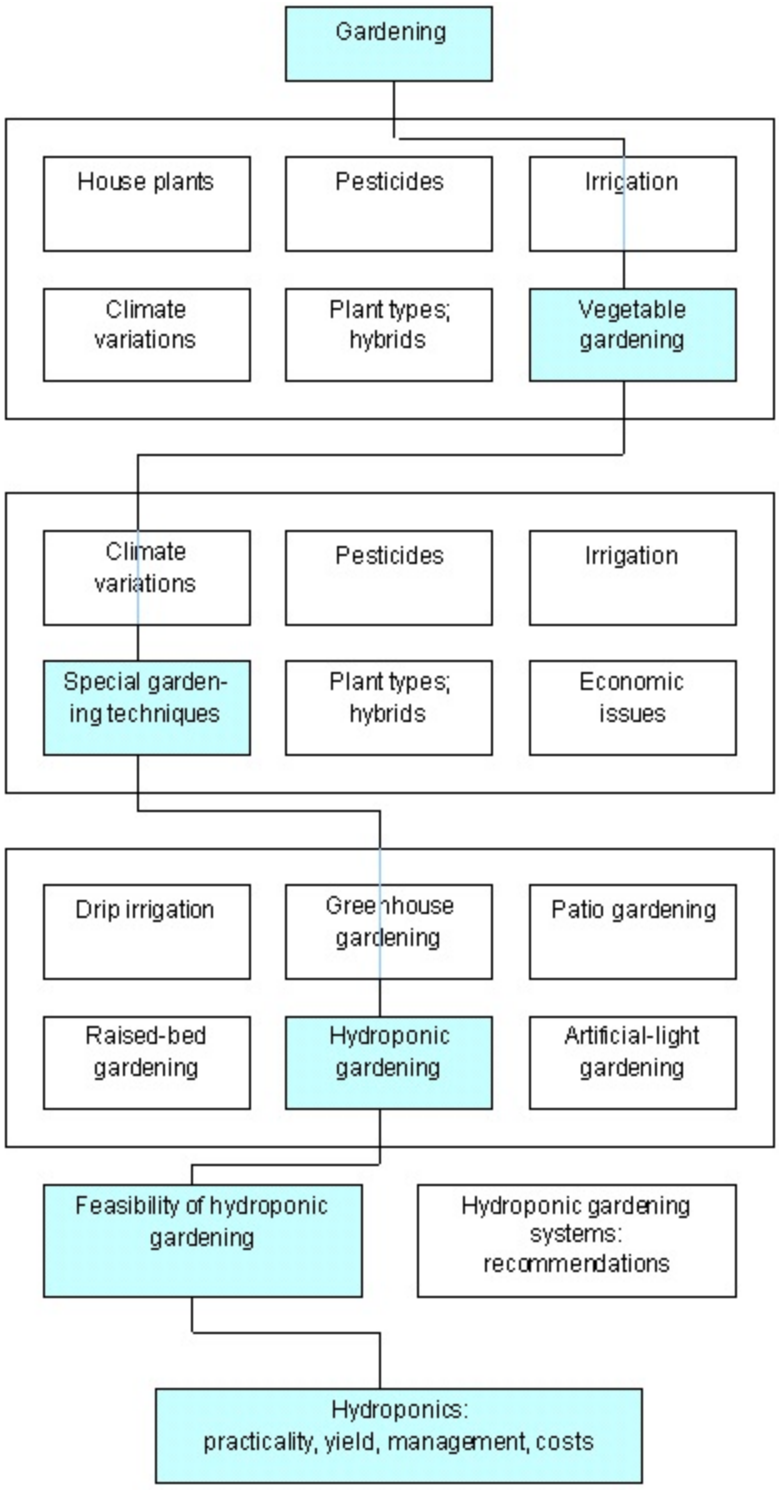
feasibility:

gardening >> vegetable gardening >> special gardening techniques >> hydroponic gardening >> feasibility/recommendations relating to hydroponic gardening >> general feasibility of hydroponics gardening

7. Another chapter in this book presents several kinds of feasibility: practical feasibility, whether it works; economic feasibility, whether it's too expensive and whether it pays for itself or offers economic advantages; implementation feasibility, whether it's too much trouble, whether you have to remodel your entire garage; and feasibility in terms of the yield and quality— whether hydroponically grown vegetables are any good.
8. So what's it going to be? You know that you want answers to these questions: does hydroponic gardening work? what's the yield? is it any good? how much of a hassle is it? how expensive and how difficult is it to build your own system? and what do you need—in general terms—to build a system? Is this too much for a semester report in a technical-writing course?

gardening >> vegetable gardening >> special gardening techniques >> hydroponic gardening >> feasibility/recommendations relating to hydroponic gardening >> general feasibility of hydroponics gardening >> hydroponic gardening: practicality, yield, management, and costs

9. You've come a long way from "gardening," but you may still need to keep going. Actually, you've done one other narrowing operation without noticing: the focus is small-time, hobbyist, or "home" hydroponic gardening—not commercial hydroponic gardening. In any case, you have four main questions: (a) how does it work, (b) how well does it work, (c) how much work is it, and (d) and what are the costs? These translate into the subtopics you see at the very bottom of this flow chart:



1. To this point, you've been operating in a vacuum, not considering audience and situation, focusing instead on *your interests* in this topic. Now it's time to get real—to define a real or realistic audience and situation. Who wants this document? Who would hire you (hydroponics expert) to write it? How would people obtain this document? Imagine that a hydroponics association, club, or special-interest group sends out a request for proposals (RFP). Its members want a technical writer to develop an overview guide on hydroponics: not a how-to, not a parts list—just an introduction answering people's questions and concerns. The organization will ship your overview to anybody who inquires about the topic—and the organization will pay you for all of this great work.
2. Are we there yet? Not quite. Narrowing means two things: zooming in on progressively

smaller and smaller subtopics; but also deciding on level and amount of detail. In this hydroponics overview, must you cover the four subtopics in excruciating detail? No, at most you'll want to cover practicality in moderate detail: readers need enough detail to see that the method actually works. Use the same amount of detail for yield, perhaps citing some comparative studies. But use only light detail for management and costs. You must keep this overview relatively brief and readable. Notice that these four main topics are not in the best sequence; we'll get to that in the outlining phase:

Home hydroponics system: topics	
Costs—how expensive to build and run a system?	light detail
Practicality—do they really work?	moderate detail
Management—how much hassle?	light detail
Yield—how much and how good is the produce?	moderate detail

Finishing the Process

In the end, try to produce something that is integrated with a real or realistic situation like this:

What does the RFP that you are responding to request?	An avid association of US hydroponic gardeners wants to spur interest in this method by being able to distribute some sort guide regarding the method.
Describe the organization or individual making the request.	American Home Hydroponics Association is an advocacy group seeking to spur interest in this gardening method and to support current membership with techniques and troubleshooting advice.
How will the organization or individual use the requested document?	The AHHA will advertise this guide in gardening magazines and send hardcopy to people who

	are interested but without Internet connection. Also, it will post links to the PDF guide on its website.
If the requesting organization will make the document available to others, who are those people and how will they get the document?	The requested guide will be aimed at an audience of gardeners but assume nothing about their knowledge of hydroponics. It will seek to spur their interest.
What kind of document is requested? What is the purpose of the document?	It will be a guide enabling people to get interested in hydroponics and see how to get started.
What are the characteristics of the target readers of the document (knowledge, background, experience)?	The requested guide will be aimed at an audience of gardeners but assume nothing about their knowledge of hydroponics. It will seek to spur their interest.

Sexy Technical Communication Home

Outlining-Generating Items and Sequencing Them

When you write a technical report, not only must you think of the right information to include (or exclude); you must also find a good way to arrange it. This is a two-part chapter: this part focuses on generating outline items and sequencing them; the second part focuses on turning a rough outine into a good, polished outline.

Outlines for technical reports are usually hard to handle solely in your mind; it's a little like trying to add a list of large numbers mentally. You must get report outlines in print in order to think about the arrangement of the topics within them. A good working outline serves you in at least four important ways:

- It shows you which areas of information to investigate and gather information on.

- It shows you which areas you can safely ignore (thus saving you plenty of time).
- It enables you to schedule your work into manageable units of time.
- It gives you a "global" view of your report project, an overall sense of the contents, parts and organization of the report.

Generating Outline Elements

If you go through a brainstorming process, you have generated a rough list of topics that you can start working with. The topic list below concerns cocombustion, which is the incineration of municipal solid waste (MSW) with conventional fuels to reduce conventional fuel consumption costs and related MSW disposal problems. Imagine that you had developed a topic list on this subject and then had narrowed the list to these topics:

Advantages of cocombustion
Steps in cocombusting MSW
Disadvantages of cocombustion
Historical background on cocombustion
Economics of cocombustion
Special components for cocombustion
Composition of MSW
Cocombustion power plant construction costs
Cocombustion power plant operating costs
Economic advantages of cocombustion
Environmental advantages of cocombustion
Characteristics of municipal solid waste (MSW)
Environmental disadvantages of cocombustion
Methods of MSW disposal

Grouping, Combining, and Subordinating Outline Elements

You can tell that the list above needs serious help:

- You can see that a number of topics involve advantages and disadvantages; these might be combined in a more general outline called Advantages and Disadvantages of Cocombustion. The specific related topics would be *subordinated* beneath this more general topic: Advantages and Disadvantages of Cocombustion
  Advantages of cocombustion
  Disadvantages of cocombustion

- But wait a minute! One of the advantages has to do with economics. So we could create another group: Economics of cocombustion
  Economic advantages of cocombustion
  Cocombustion power plant construction costs
  Cocombustion power plant operating costs
- So what do we do with Environmental advantages of cocombustion and Environmental disadvantages of cocombustion? It might be best to create a higher-level heading Environmental aspects of cocombustion and subordinate those other two beneath it. And so that means we no longer need Advantages and Disadvantages of Cocombustion. It has been split into an economics group and an environment group.
- Looking further at the rough list of topics, you can probably see that Steps in cocombusting MSW, Special components for cocombustion, Composition of MSW, Characteristics of municipal solid waste (MSW) are related to each other and should exist in their own area of the outline.

So this is how the business of generating, grouping, combining and subordinating works early in the outlining process. Outlining is a messy process so you'll probably come back to this phase again.

Sequencing Outline Elements

The next step in outlining is to sequence the items appropriately. There are so many different patterns of sequencing that only most common ones can be reviewed here. And, frankly, these are all pretty obvious. If they are obvious to you, skip to Elaborating the rough outline.

- Chronological sequencing. One of the most common patterns in outlining is the chronological one. In a historical background section of an outline, the chronological approach is just about the only one you can use. Here is an outline excerpt concerning the historical background of nuclear research:

  > II. Historical background of nuclear research A. Becquerel's theory of radition in uranium (1896) B. The work of the Curies *(far* C. The work of Rutherford *past)* 1. Demonstration of the internal structure of the atom (1911) 2. Transmutation of atoms (1919) D. Development of technology to study atomic structure 1. Cascade transformer (1928) 2. Linear accelerator (1931) 3. Cyclotron (1932) 4. Betatron (1940) E. Hahn-Strassmann discovery of uranium fission (1938) F. Oppenheimer work on nuclear chain reactions *(near* (1940s) *past)* G. Explosion of the first atomic bomb (1945)

  In some outlines, however, you almost don't notice the chronological pattern. For example, effects come after causes; solutions, after problems; or findings, after research method. The chronological pattern is most important in a research proposal

outline:

> I. Introduction A. Historical background on caffeine studies *(past)* B. Objectives of the study C. Limitations of the study D. Plan of development II. Review of the literature on caffeine III. Experimental method to be used IV. Results of the tests V. Discussion of the results VI. Summary and conclusions VII. Implications for further research *(future)*

Chronologically, the researcher first defines the problem, the reviews the literature on the problem, plans a research method, conducts the research and gathers data, analyzes the data and draws conclusions from it. Afterward, she may consider areas for further research on the problem.

- At-rest to in-motion sequence. Another common outlining pattern is to start with an object at rest, motionless as if in a photograph, and then to move to a discussion of it in operation, in action as if in a motion picture.

> II. Basic Components of Wind-Powered Electrical Systems A. Rotor *(motionless)* B. Generator C. Tower III. Basic Operation of Wind-Powered Electrical Systems A. Wind energy into mechanical energy B. Mechanical energy into electrical *(in motion)* energy C. Stabilization of electrical energy D. Conversion to household current

- Specific to general sequence. Some outlines move from a specific, close-up focus to a more general, panoramic focus. They seem to start with a microscope, examining the minute details of a subject, and end with a telescope, considering the subject from a distance in relation to other things. (This pattern can also be reversed.)

> I. Introduction II. Characteristics of municipal solid waste (MSW) III. Methods of disposal of MSW *(microscope)* IV. Processing municipal solid waste V. Plant modifications for cocombustion VI. Advantages of cocombusting MSW A. Environmental advantages B. Economic advantages *(telescope)* VII. Case studies of three cocombustion plants

In this next outline, the focus broadens after part III, changing to aspects related to computerized voice recognition technology:

> I. Introduction II. Human voice production A. The generation of sound B. Factors affecting the human *(microscope)* voice III. Components of the isolated word recognition system A. The preprocessor B. The feature extractor C. Components in the classification phase D. Decision algorithms IV. Problems with computerized speech recognition A. Accuracy B. Limited vocabulary size C. Privacy V. Applications of voice recognition systems A. Data entry B. Mobility C. Security D. Telephone access E. Devices for the handicapped *(telescope)* VI. Current availability of speech recognition systems VII. The future of the computerized speech recognition industry

- Rhetorical sequence. Elements in outlines can also be arranged rhetorically, in other words, according to what is most effective for the reader. Here are some examples of rhetorical patterns:

- Simple to complex
- Least important to most important (or vice versa)
- Least controversial to most controversial
- Most convincing to least convincing (or vice versa)
- Most interesting to least interesting

This list is by no means complete: but you can see that elements in it are arranged according to impact on the reader—that is, the impact the writer would like to have. Here are some excerpts of outlines where these patterns are used.

If you have ever studied computer programming, you know that commands like PRINT are simple; variable assignment commands (like LET A = 30), less simple; and FOR-NEXT loop statements, rather complex. If you were outlining a report on fundamental BASIC commands for the beginner, you'd probably start with the simple ones and work your way to the complex:

Simple-to-complex order III. USEFUL BASIC COMMANDS A. PRINT B. LET C. IF-THEN D. FOR-NEXT E. DIM

If you were writing a report on cocombustion of municipal solid waste (MSW) for a city concerned about skyrocketing coal costs, you could arrange your advantages section two ways: (a) save the "reduction of coal consumption" for last in order to build up to a climax, or (b) introduce it right away to grab the citizens' attention:

Climax order Attention-getting order (least-most important) (most-least important) A. Recovery of revenue from A. Reduction of coal use and recyclable MSW and related costs B. Reduction of landfill B. Reduction of landfill use, costs, and other re- use, costs, and other re- lated problems lated problems C. Reduction of coal use C. Recovery of revenue from and related costs recyclable MSW

- An obvious outlining principle is to avoid creating interruptions within an outline sequence. Here's an example:

Outline excerpt with interruption I. Municipal solid waste generated in the US A. Total amounts of MSW 1. Increases since 1950 2. Projected increases to the year 2000 B. Processing MSW for cocombustion 1. Primary storage 2. Grinding 3. Air sorting 4. Magnetic separating 5. Screening 6. Secondary storage C. Characteristics of MSW 1. Composition of MSW a. food waste b. paper and other rubbish c. noncombustibles 2. Factors affecting enery content a. moisture content b. areas of MSW origination II. Power plant modifications for cocombustion
Revised outline excerpt I. Municipal solid waste generated in the US

A. Total amounts of MSW 1. Increases since 1950 2. Projected increases to the year 2000 B. Characteristics of MSW 1. Composition of MSW a. food waste b. paper and other rubbish c. noncombustibles 2. Factors affecting enery content a. moisture content b. areas of MSW origination II. Processing MSW for cocombustion A. Primary storage B. Grinding C. Air sorting D. Magnetic separating E. Screening F. Secondary storage III. Power plant modifications for cocombustion

In the problem version, the municipal solid waste discussion is interrupted by the MSW-processing discussion. A better arrangement would be to discuss MSW fully before going on to the discussion of how it is processed. Use these common arrangement principles to get your topic list into an initial rough order. The rearranged version of the topic list shown previously might look this way:

I. Historical background A. Rising energy, utility costs B. Search for alternatives (review) II. Composition of MSW III. Special components of the cocombustion plant IV. Steps in the cocombustion of MSW V. Economics A. Cost to build or convert B. Cost to operate C. Cost of produced electricity VI. Advantages A. Less coal used B. Reduction of utility rates C. Less landfill used D. Reduction of landfill costs and needs VII. Disadvantages A. Expense of converting existing facilities B. Handling MSW C. Increased emissions

---

Adjusting Items in an Outline

You should also make sure that items in your outline are on the right level. Here is an example of this problem and a revision:

Unadjusted outline A. Plant Modifications for Coc- combustion 1. Storage areas 2. Conveyor lines 3. Boiler modifications 4. Air control equipment B. Economic Benefits C. Environmental Benefits

Revised outline A. Plant modifications for Co- combustion 1. Storage areas 2. Conveyor lines 3. Boiler modifications 4. Air control equipment B. Benefits of Cocombustion 1. Economic benefits 2. Environmental benefits

In this revision, the problem was solved by adding a more general item (Benefits of Cocombustion) and downshifting the original "B" and "C" items. Now, here's another example:

Unadjusted outline B. Environmental Benefits C. Reduction of Landfill Needs D. Economic Benefit

Revised outline B. Environmental benefits 1. Reduction of landfill needs 2. Reduction of Coal Consumption C. Economic benefits

Here, Reduction of Landfill Needs is really a subdivision of Environmental Benefits. Downshifting it to a "1" creates a single-item entry, however. Therefore, we might add a second item like Reduction of Coal Consumption.

Sexy Technical Communication Home

Note-Taking Methods

Electronic Note-Taking Methods

As of 2015, the writing-teaching world—at least at the college level and in terms of textbooks—is seriously behind in terms of what it knows and what it teaches about note-taking for major writing projects. Strangely, the very best writing resource on the Intenet, the Purdue OWL, has nothing on note-taking. Read the following section Traditional Note-Taking Methods for a review of just what good *any* note-taking system is.

Until we get our act together, consider how the traditional note-taking system is implemented in software applications.

A number of software applications are available that support note-taking and related tasks: Evernote, EasyBib, NoodleTools, and more. Their basic functions are similar so let's use NoodleTools. It has a nice set of YouTube videos that walk you through the main phases of its use:

How do I create a new project? This video takes you from the very start!

How do I to create a notecard for my citation? In this video, you see how to create a single notecard. In one panel of that view, you can paste the direct quotation; in another, your understanding, paraphrase, or summary of it; in still another, you can jot down ideas and questions; and in another, you can enter the URL or the traditional bibliographical source of the information plus search tags. The video concludes with a demonstration of moving the new notecard to the "tabletop," grouping notecards, and using them to create an outline.

NoodleTools—Creating Outlines. If you've created good notecards, creating the outline from them is terrific, as this video shows.

Noodle Tools Works Cited. If you've created good notecards, creating the bibliography from them is also terrific.

Traditional Note-Taking Methods

When you've located the right sources of information for your report, it's time to start gathering the right information from them and developing it into a report. In other words, it's time to start reading, summarizing, paraphrasing, interviewing, measuring, calculating, and developing information any other way your report project requires. The technical report may be one of the largest writing projects that you've ever tackled: you may wonder how you are going to do all that reading and remember all that information. Concerning the reading, here are several suggestions:

- Develop as specific an outline as you can: it shows you what information you must gather and, as importantly, what information you can ignore.
- Use the indexes, tables of contents, and headings within chapters to read books selectively for just the information you need.
- Divide your work into manageable, hour-long chunks (make progress rather than relying on big blocks of weekend or vacation time).

As for remembering the information you gather for your report, the most practical suggestion is to use some form of note-taking. Note-taking refers to any system for collecting and storing information until you can use it in the report. Note-taking involves the skills of summarizing, paraphrasing, or quoting. A good system of note-taking is one that enables you to gather a large amount of information over a long period of time and to be able to use that information without having forgotten it or lost it in the meantime.

Traditional Note-Taking Process: An Overview

In the traditional system of taking notes for a long report, you:

1. Develop a rough outline.
2. Do any preliminary reading necessary to construct a rough outline.
3. Locate your information sources, and make bibliography cards for each source.
4. Take the actual notes on index cards.
5. Label each notecard according to its place in the outline.
6. Provide bibliographic information on each notecard.
7. Change or add extra detail to the outline as the note-taking process continues.
8. Check off the areas of the outline for which sufficient notes have been taken.

When you have taken sufficient notes to cover all parts of an outline, you transcribe the information from the notecards into a rough draft, filling in details, adding transitions, and

providing your own acquired understanding of the subject as you write. Naturally, you may discover gaps in your notes and have to go back and take more notes.

Developing the rough outline

As the section on outlining emphasizes, you must have a working outline before you begin gathering information. The rough outline shows you which specific topics to gather information on and which ones to ignore. Think of the outline as a series of questions:

Rough outline for a report	Questions generated by the outline
light water nuclear reactors	
I. Pressurized Water Reactors	
A. Major Components	What are the main differ- ences? what are the main components?
B. Basic Operation	what are the materials? design? dimen- sions? how many are in op- eration? where? who designed them?
II. Boiling Water Reactors	How does they differ from PWRs?
A. Major Components	What are the main components?
B. Basic Operation	What are the materials? de- sign? dimensions? designers? where used? how many?
III. Safety Measures	What are the chief dangers?
A. Pressurized Water Reactor	What are the dangers and safety measures associated with PWRs?
B. Boiling Water Reactors	What are the dangers and safety measures associated with BWRs?
C. Role of the Nuclear Regu- latory Commission	How does the NRC regulate nuclear power plants? what standards does it enforce? how?
IV. Economic Aspects of Light Water Reactors	What are the construction, operation, maintenance, and fuel costs? what about the availa- bility of fuel? how do these costs compare to output? how do the PWR and the BWR compare in terms of costs and output?
A. Construction Costs	
B. Operation and Maintenance Costs	
C. Operating Capacity	How much electricity can a LWR generate at full capacity

Figure 1. Viewing an outline as a series of questions

If you don't have a good, specific outline, the sky is the limit on how many notes you can take. Think of the outline as a set of boxes that you fill up with the information you collect as you do your research for the report:

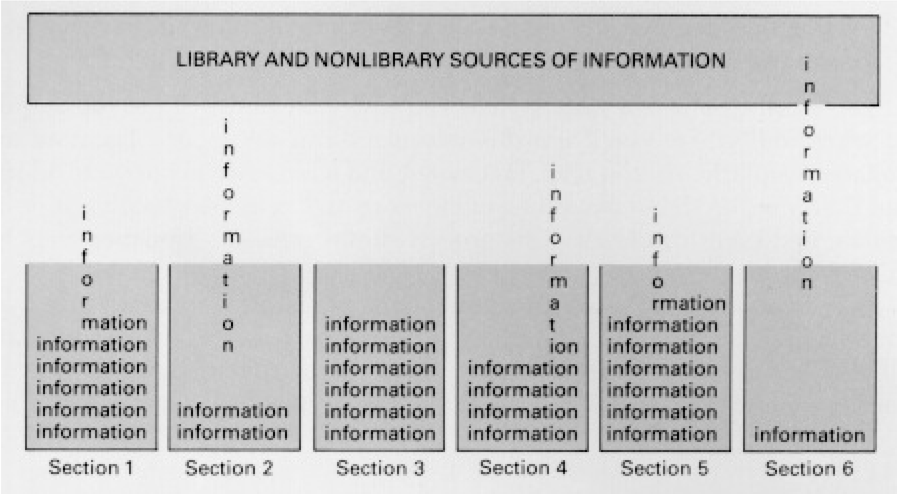


Figure 2. Gathering information and taking notes: you continue gathering information from the various sources until all the boxes are filled.

Information on the bibliography cards

On the bibliography cards you should record information that enables you or your readers to locate the books, articles, reports, and other sources. Remember that you'll use this information to create the bibliography or list of references for your report. See the examples of bibliography cards for books, magazine articles, encyclopedias, and government documents; the section on documentation shows you details on the information to record on many different types of sources, but remember these general guidelines:

- For books, record the "facts of publication": the city of publication, the publisher, and the date of publication.
- For magazines, record the title of the magazine, the date of issue of the specific magazine, and the beginning and ending page numbers of the article.
- For encyclopedia articles, record the edition number and date of the encyclopedia, and look up the authors' initials.
- For government documents, disregard the authors' names, use the department, administration, or agency name as the author, and copy the cataloguing number.
- For any private sources of information you use, for example, interviews or letters, record the date of the communication, the source's full name, title, and organization with which he or she is affiliated.

Information on the notecards

In the traditional note-taking system, a notecard typically looks like this:

BWR—fuel rod (III,A,1,b) fuel rod material—Zircaloy (same as PWR fuel rod) 148 in. long X 0.493 in. diam. slightly longer >' PWR fuel rod 16 D, 749

Figure 3. A typical notecard

This notecard has the following features:

- A word, phrase, or number that indicates where it fits into the outline (the "locator").
- Bibliographic information: that is, an abbreviation for the source of the note (book, article, etc.) and a page number.
- The note itself, the information that will go into the report.
- A number that indicates the notecard's place in the final arrangement of all the notecards.

Locator. The "locator" phrase or number tells you where the note fits into the outline, that is, when and where you'll use this information in the report. Locaters must be updated regularly. As you read, take notes, and learn more about your subject, you can flesh out, or "elaborate," your outline more and more, subdividing it into third, fourth, and even fifth levels. This process is illustrated in the section on **updating the outline**.

Bibliographic information. Each notecard must also contain bibliographic information, those details about the source of the note: the author, title, page number, and so on. Rather than write all such information on each notecard, use abbreviations: assign a letter to each source, and keep track of the sources on bibliography cards, as shown above.

Methods of recording information on notecards

The actual information that you record on the index card is rather small: a few statistics or a sentence or two, and not much else. You take such small bits of information to make it easier to "shuffle" your notecards into the sequence in which you'll use them in writing the rough draft. There are three ways of recording the information on notecards:

- Directly quoting it, copying the information directly from the source word-for-word
- Paraphrasing it, retaining the full detail of the information but in your own words
- Summarizing it, condensing the main points in the information *in your own words*

See what the Purdue OWL has to say about these methods.

Direct quotation. In most technical reports, direct quotation is needed only for the following situations:

- Statements by important or well-known authorities or leaders
- Controversial statements you do not want attributed to you
- Statements expressed in unusual, vivid, or memorable language

Here is an example notecard with a direct quotation:

Myers, author of The Nuclear Power Debate and somewhat of a supporter of nuclear, emphs heavy inspect and penalties: During the period between July 1, 1975 and September 30, 1976 the NRC listed 1,611 items of noncompliance. Only six of these were considered serious violations, 923 were classi- fied as infractions, and 682 were noted as deficiencies. The NRC issued fines to ten utilities totaling $172,250 between July 1, 1975 and December 15, 1976. NRC officials report that the limited use of fines and the efforts to get industry to regulate itself have worked. "By and large," one NRC offi- cial told IRRC, "I think our enforcement program is working." H, 46

Figure 4. Original passage and notecard with direct quotation

When you copy a direct quotation onto a notecard, remember to do a few extra things that will save time and frustration later on:

- Write a lead-in to introduce the quotation, citing the author's name and any other important information about the author.
- Write a brief explanation, interpretation, or comment on the quotation you've just copied.

There are essentially two types of direct quotation: "block" quotations and "running" quotations. Here is an example of a block quotation (any quotation over 3 lines long, which is indented):

In Myers' view, the nuclear power industry has every reason to comply with the NRC's regulations to the very letter: The NRC issues an order to shut down or imposes civil fines only after repeated violations have in- dicated what the NRC considers "a pattern of non- compliance." The NRC argues that, particularly with power plants, civil penalties are unnecessary for the most part. "The greatest penalty," one official said, "is to require the plant to shut down, forcing it to buy replacement power (often at a cost of $100,000 to $200,000 per day) elsewhere. A civil penalty's largest cost—the NRC is limited to a $5,000-per-violation ceiling per 30 days—is the stigma attached to it." (8:46) The "stigma" refers to the fact that, once a nuclear power plant is fined, it will likely be the target of public con- cern and even more stringent and frequent NRC inspection.

Figure 5. Block quotation and a running quotation

"Running" quotations are direct quotations that are trimmed down and worked into the regular sentences of a report. Notice how much smoother and more efficient the running quotation is in the revised version below:

Ineffective direct quotation There are two types of light water reactors: the pressurized water reactor and the boiling water reactor. LWRs of both types convert heat to electricity with an efficiency of about 32 percent—significantly less than the best fossil-fueled plants, although about equal to the national average for all thermal electricity generation [13:438]. As for harnessing the energy potential of uranium, LWRs are estimated to average only between 0.5 and 1.0 percent.
Revision with running quotation There are two types of light water reactors: the pressurized water reactor and the boiling water reactor. According to Paul Ehrlich, who has been a consistent critic of nuclear power, both these types of LWRs "convert heat to electricity with an efficiency of about 32 percent—significantly less than the best fossil-fueled plants, although about equal to the national average for all thermal electricity generation" (13:438). As for harnessing the energy potential of uranium, LWRs are estimated to average only between 0.5 and 1.0 percent.

Figure 6. An ineffective block quotation revised as a running quotation

Guide for using direct quotations

When you use direct quotations in your report, keep these guidelines in mind.

Figure 7. Using ellipsis in direct quotations. The three dots "..." show that words are omitted from the sentence. The brackets "[ ]" indicate changes made by the writer using the quotation so that it would read as good English and make sense.

- Never use "free-floating" quotations in reports. Always "attribute" direct quotations; that is, explain who made the quoted statement. Notice how this is done in Figure 6.
- Always provide adequate introduction for direct quotations and explain their meaning and importance to your readers. Notice how the block quotation above on NRC penalties (a) prepares the reader for the quotation, and, afterwards, (b) provides interpretive comment, on the meaning of the word "stigma" in particular.
- Use indented or "block" quotations whenever a direct quotation goes over three lines long. With any lengthy quotation, make sure that it is important enough to merit direct quotation.
- Whenever possible, "trim" the quotation so that it will fit into your own writing. Notice

how the words that are less important are omitted in Figure 5.

- Punctuate direct quotations correctly. You can see the rules for punctuating direct quotations; however, here are some examples of the most common ways to punctuate quotations:

> According to Desaix Myers in his The Nuclear Power Debate, "The NRC has nearly 400 staff members assigned to inspect nuclear plants now operating or under construction." NRC officials also inspect nuclear power plants "an average of 50 times during the period before operation" when they are under construction and "a minimum of four times a year" after the plants go into operation. Myers points out that standardization of nuclear power plant design is an important next step: "The NRC estimates that by standardizing plants..., the time between a decision to go nuclear and start-up of plant operations can be reduced from 11 to 6 years."

- Use ellipses to shorten direct quotations. When you do, however, make sure that the resulting quotation reads as good English. Here is an example passage:

> Ehrlich argues that a mistaken notion of the breeder reactor has been promoted in the United States: [Although breeder reactors] can harness so much more of the potential energy in uranium and thorium than non- breeders[, i]t is worth emphasizing that a breeder does not get something for nothing.... Paul R. Ehrlich, Anne H. Ehrlich and John P. Holdren, Ecoscience: Population, Resources, and Environ- ment, (San Francisco: Freeman, 1977), p. 441. Ehrlich goes on to argue that breeder reactors are ...

- Use direct quotations only when necessary: if the passage doesn't fit one of the reasons for direct quotation cited at the beginning of this section, paraphrase or summarize it instead.

Paraphrasing. In technical-report writing, usually the better approach to note-taking is to paraphrase. When you paraphrase, you convey the information fact-by-fact, idea-by-idea, and point-by-point in your own words. The writer of the original passage ought to be able to read your paraphrase and say that it is precisely what she or he had meant. Here are some example paraphrased notecards:

BWR—fuel assembly (III,A,1,3) fuel assembly—63 f rods spaced, supported in a sq (8 x 8) arrangement by upper + lower plate 3 kinds: (a) tie rods; (b) water rod); (c) stand f rods 3rd, 6th f rods on a bundle's outer edge act as tie rods the 8 tie rods screw into castg of lower tie plate water rod: acts as spacer support rod, as source of moderator material close to the center of f bundle K, 2001
BWR—fuel assem (III,A,1,3) fuel channel—enclosure for f bundle; f bundle + f channel make up fuel assem is a tube with a square shape, made of Zircaloy dimensions: 5.518 in. X 5.518 in. X 166.9 in. function: channel core coolt thru f bundle and guide control rods K, 2001

Figure 8. Paraphrased notecards

Paraphrases are necessary and preferable for a number of reasons:

- You paraphrase because the content of the passage is so important to your report that you need every bit of it.
- When you paraphrase, you adjust the wording of the original to meet the needs of your audience, the purpose of your report, and your own writing style. In other words, you "translate" other writers' material into your own.
- A report of mostly direct quotations would be hard to read.
- Readers tend to skip over direct quotations, particularly long ones.
- One final reason for paraphrasing: you are actually writing bits of the rough draft of your report as you paraphrase.

Here is an example of an original passage and its paraphrases, with the unique wording of the original (which must be changed in the paraphrase) underlined.

Original passage About a third of light-water reactors operating or under construction in the United States are boiling-water reactors. The distinguishing characteristic of a BWR is that the reac- tor vessel itself serves as the boiler of the nuclear steam supply system. This vessel is by far the major component in the reactor building, and the steam it produces passes directly to the turbogenerator. The reactor building also contains emergency core cooling equipment, a major part of which is the pressure suppression pool which is an integral part of the containment structure. . . . . earlier BWRs utilized a somewhat different containment and pressure suppression system. All the commercial BWRs sold in the United States have been designed and built by General Electric. Several types of reactors that use boiling water in pres- sure tubes have been considered, designed, or built. In a sense, they are similar to the CANDU, described in Chapter 7, which uses pressure tubes and separates the coolant and mo- derator. The CANDU itself can be designed to use boiling light water as its coolant. The British steam-generating heavy- water reactor has such a system. Finally, the principal reac- tor type now being constructed in the Soviet Union uses a boiling-water pressure tube design, but with carbon modera- tor. Anthony V. Nero, A Guidebook to Nuclear Reactors, Berkeley: University of California Press, 1979.
Paraphrased version Boiling water reactors, according to Anthony V. Nero in his Guidebook to Nuclear Reactors,

either completed or constructed, make up about one third of the light-water reactors in the U.S. The most important design feature of the BWR is that the reactor vessel itself acts as the nuclear steam supply system. The steam this important component generates goes directly to the turbogenerator. Important too in this de- sign is the emergency core cooling equipment which is housed with the reactor vessel in the reactor building. One of the main components of this equipment is the pres- sure suppression pool. The containment and pressure sup- pression system currently used in BWRs has evolved since the early BWR designs. General Electric is the sole design- er and builder of these BWRs in the U.S. The different kinds of reactors that use boiling water in pressure tubes are similar to the CANDU, which separates coolant and moderator and uses pressure tubes also. CANDU can also use boiling light water as a coolant. The British have designed a reactor generated steam from heavy water that uses just such a system. Also, the Soviets have de- veloped and are now building as their main type of reactor a boiling pressure tube design that uses carbon as the moderator. [12:232]

Figure 9. Avoiding the original wording in paraphrases

Guide for writing and using paraphrases

Here are some guidelines to remember when paraphrasing:

- In most cases, paraphrase rather than use direct quotation.
- Avoid the distinctive wording of the original passage.
- Do not interpret, criticize, or select from the original passage.
- Include bibliographic information on the author, source, and page numbers.
- In the rough draft, cite the author's name and other important details about her or him just as you would if were quoting directly. In Figure 9, notice how the paraphrased author's name is given early.
- Refer to the paraphrased author in such a way to make it clear where the paraphrase begins and ends. (See Figure 9.)
- Document a paraphrase just as you would a direct quotation. Mark the area of the paraphrase by citing the paraphrased author's name at the beginning of the paraphrase and by inserting a footnote or parenthetical reference at the end. (Again, see Figure 9.)
- See what the Purdue OWL has to say about paraphrasing.

Summary. Summaries are usually much shorter than their originals. A summary concentrates on only those points or ideas in a passage that are important. Unlike in a

paraphrase, the information in a summary can be rearranged. Here is a passage from which summaries below will be taken:

Numerous systems are available for controlling abnormali- ties [in boiling water reactors]. In the event that control rods cannot be inserted, liquid neutron absorber (containing a boron compound) may be injected into the reactor to shut down the chain reaction. Heat removal systems are available for cooling the core in the event the drywell is isolated from the main cooling systems. Closely related to the heat removal systems are injection systems for coping with de- creases in coolant inventory.

Both abnormalities associated with the turbine system and actual loss of coolant accidents can lead closing of the steam and feedwater lines, effectively isolating the reactor vessel within the drywell. Whenever the vessel is isolated, and indeed whenever feedwater is lost, a reactor core isolation cooling system is available to maintain coolant inventory by pumping water into the reactor via connections in the pressure vessel head. This system oper- ates at normal pressures and initially draws water from tanks that store condensate from the turbine, from con- densate from the residual heat removal system, or if neces- sary, from the suppression pool.

A network of systems performs specific ECC [emergency core cooling] functions to cope with LOCAs [loss-of-cool- ant accidents]. (See Figure 6.) These all depend on signals indicating low water level in the pressure vessel or high pressure in the drywell, or both.

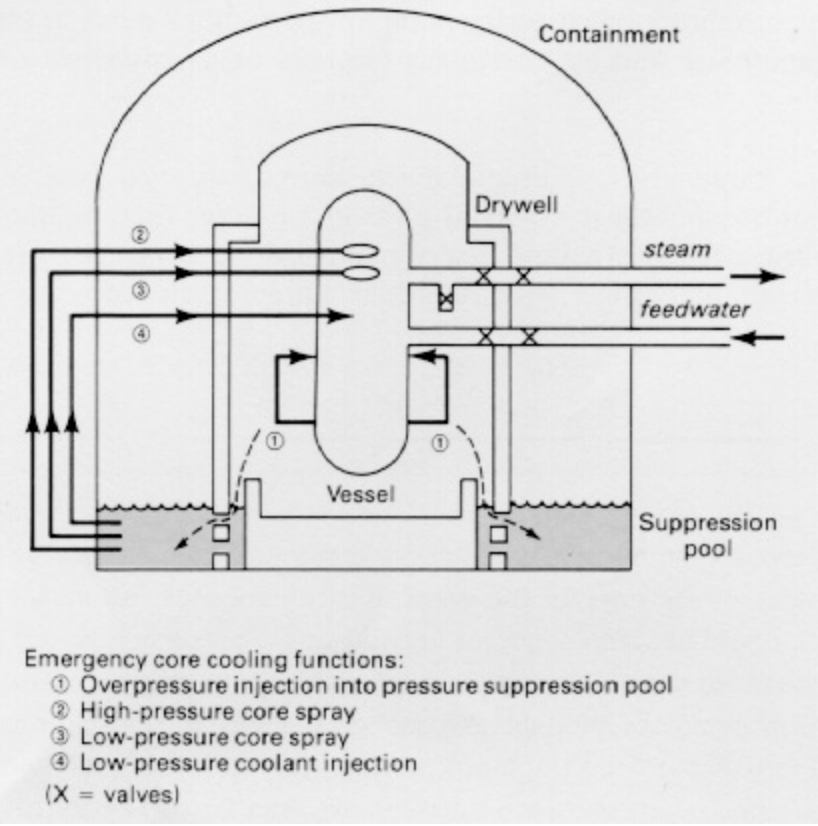


Figure 6. BWR emergency core cooling systems

The systems include low-pressure injection, utilization of the RHR system, and high- and low-pressure core spray systems. The high-pressure core spray in intended to lower the pressure within the pressure vessel and provide makeup water in the event of a LOCA. In the event the core is uncovered, the spray can directly cool the fuel assemblies. Water is taken from the condensate tanks and from the suppression pool. On the other hand, should it become necessary to use low-pressure systems, the vessel must be depressurized. This can be accomplished by opening relief

valves to blow down the vessel contents into the drywell (and hence the suppression pool). Once this is done, the low-pressure core spray may be used to cool the fuel assemblies (drawing water from the suppression pool) or RHR low-pressure injection (again from the sup- pression pool) may be initiated, or both. The RHR system may also be used simply to cool the suppression pool. (Two other functions of the RHR are to provide decay heat removal under ordinary shutdown conditions and, when neces- sary, to supplement the cooling system for the spent fuel pool and the upper containment pool.)

Anthony V. Nero, A Guide- book to Nuclear Reactors, Berkeley: Univ. of California Press, 1979, pp. 104-107.

Figure 10. Passage to be summarized

Sentence-length summaries. Often summaries are only a sentence long. To create sentence-length summaries, use one or a combination of the following methods:

- Locate a sentence or two in the original passage that summarizes the information that you want, and simply rewrite it in your own words. Find the sentence in the third paragraph of the original that is the basis for this summary:

  BWR—safety sys (IV,B,2) The systems that perform emergency core cooling functions in loss-of-coolant accidents include low-pressure injection, utilization of the RHR system, and high- and low-pressure core spray systems. I, 104

- If no individual sentence will work, locate several sentences that contain the right information, and combine them. (This summary sentence is built from paragraphs 1 and 2 of Figure 10.)

  BWR—safety sys (IV,B,2) In case of problems with control rods or loss of coolant, BWRs use an absorber to stop the reaction or emergency systems to replenish and maintain coolant around the reactor core, respectively. I, 104-107

- Sometimes, the summary sentence is like a new sentence, scarcely resembling any in the original. Here is a different summary sentence on the passage above; notice how new it seems:

  BWR—safety sys (IV,B,2) If the control rods malfunction, a substance can be introduced to shut down the reaction altogether, and if water is prevented from reaching the reactor core, BWRs are equipped with backup sources of coolant that can be sprayed or injected into the pressure vessel. I, 104-107

Extended summaries. A summary can be longer than a single sentence because of the important information contained in the original passage. (Remember, however, that a paraphrase is a point-by-point recap of the original, while the summary is a selection, reordering and condensation of the original.) Here's an extended summary of the passage

above on BWR emergency safety systems (Figure 10):

> Boiling water reactors use numerous systems to control abnormalities in reactor operations. If a problem with control rods occurs, a liquid neutron absorber can be injected to halt the chain reaction. If coolant is cut off from the reactor core, a reactor core isolation cooling system can maintain coolant inventory by pumping water from various storage areas. This system includes low-pressure injection, the residual heat removal system, and the high- and low-pressure core spray systems. The water supply for these various emergency systems ultimately come from the suppression pool.

Guide for using summaries

Whenever you summarize, you must handle the resulting summary the same way you would a direct quotation or paraphrase.

- Cite the name of the author and other important information about that author.
- Document that summary using whichever system is appropriate for your report.
- If it is an extended summary, make it clear where that summary begins and ends, for example, by referring to the author's name at the beginning and placing a footnote or parenthetical reference at the end.

Plagiarism. If you follow the guidelines presented in the preceding, plagiarism should not be a problem at all, but make sure you understand what it is. Plagiarism refers to two kinds of theft:

Reports with plagiarized information are often easy to spot for several reasons:

- Plagiarism is the practice—whether deliberate or not—in which a writer borrows other people's facts, ideas, or concepts and presents them as if they were her or his own.
- Plagiarism is also the practice—again whether deliberate or not—in which a writer uses other writers' exact words without quotation marks.
- In all cases, plagiarism is the lack of proper documentation: documentation refers to any system of footnoting or reference that indicates the author and source of the borrowed information.
- A reader may recognize the ideas or facts in the report as those of someone else. An expert in a field of knowledge can spot this theft of information right away.
- A reader may realize that the report writer could not possibly have developed certain information in the report. If a writer who is at the beginning of his studies sounds like an advanced physicist, something is fishy.
- Most readers can also spot a sudden change in the style or tone of the language of a

report. Most people's writing style is as readily identifiable as their voices over the telephone.

Plagiarism is bad business: the plagiarizer can fail an academic course or lose his or her reputation among business and professional associates. It only takes simple documentation to transform a report with plagiarized material in it into one with legally borrowed material. The section on documentation explains these procedures in detail.

Updating the outline

As you take notes, you must regularly update the locators on all your notecards because as you read, take notes, and learn more about your technical subject, your outline may either change or become more specific. Imagine that you started with this excerpt of a rough outline and had taken these notecards:

Rough sketch outline IV. Safety Measures A. Pressurized Water Reactor Safety Measures B. Boiling Water Reactor Safety Systems C. Role of the Nuclear Regulatory Commission
Corresponding notecards BWR—safety sys. (IV,B) safety sys incl control rods, containmt bldg, resid heat removl sys there work like those in PWR unique to BWR: drywell, emergency core coolg sys 1 I, 100
BWR—safety sys (IV,B) drywell—encloses react vess + assoc equip (includes recirc sys, press relief valves on main steam lines) 2 I, 100
BWR—safety sys (IV,B) emergency core coolg sys—handles loss-of-coolt accidents; includes reactor core iso sys, hi- press core spray sys, lo-press core spray sys (figure for this, p.106) 3 I, 105-6
BWR—safety sys (IV,B) react core iso coolg sys: if loss-of-coolt accidt (causg closing of steam lines,feedwtr lines to react vessel), RCICS activated (maintains coolt inventory by pumpg water to reactor via connex in press vess head 4 I, 104
BWR—safety sys (IV,B) hi-press core spray: lowers press w/in press vessel, provides suppl water in loss-of-coolt accidt. with uncovered cores, spray directly cools fuel assemblies (wtr fr condensed wtr storge tanks + suppress pool 5 I, 104

Figure 11. Notecards and the corresponding outline before updating

As you took these notecards, you would update your outline periodically; at the end, the outline might look like this:

Revised outline IV. Safety Measures A. Pressurized Water Reactor Safety Measures B. Boiling Water Reactor Safety Systems 1. The Drywell 2. Emergency Core Cooling Systems a. Reactor core isolation cooling system b. High-pressure core spray

Figure 12. Updated outline

Notice that all five of these notecards are about "IV. B. Boiling Water Reactor Safety Systems." Notecard 1 divides this safety system into the drywell and the emergency core cooling systems. This division produces "1" and "2" under "B." Notecards 3 through 5, about the subsystems making up the emergency systems, produce "a," "b," and "c" under "2."

If you had taken these notes and updated your outline, you would revise the locators on the individual notecards like this:

Notecard Original Updated Alternate no. locators locators locators 1 IV. B same Safety/Boil.Wtr.React. 2 IV. B IV. B. 1 Safety/BWR/drywell 3 IV. B IV. B. 2 Safety/BWR/Em.Cor.Cool. 4 IV. B IV. B. 2. a Saf./BWR/Em.Cor.Cool/ React.Cor.Cool. 5 IV. B IV. B. 2. b Saf./BWR/Em.Cor.Cool./ Hi.Pres.Cor.Spray

Figure 13. Revised locators

Remember that if you don't like the number-combinations as locators, you can substitute short phrases, as is shown in the alternate locators above.

Final stages in the notetaking process

As you take notes, check off sections of your outline for which you gather sufficient information, as is done in this outline excerpt. In this example, the writer has taken sufficient notes for much of IV.B. but still needs information for the rest of the outline.

III. Boiling Water Reactors A. Description of the Basic Components 1. Core a. core b. fuel c. fuel rod d. fuel assembly 2. Control Rods 3. Core Shrouds and Reactor Vessel 4. Recirculation System 5. Steam Separators 6. Steam Dryers B. Production of Electricity 1. Circulating Water 2. Separating Steam 3. Drying the Steam 4. Producing Electricity IV. Safety Measures A. Pressurized Water

Reactor Safety Measures 1. Residual Heat Removal System 2. Emergency Core Cooling Systems a. passive system b. low-pressure injection systems c. high-pressure injection systems 3. Containment Building B. Boiling Water Reactor Safety Systems 1. The Drywell 2. Emergency Core Cooling Systems a. reactor core isolation cooling system b. high-pressure core spray c. low-pressure core spray C. Role of the Nuclear Regulatory Commission V. Economic Aspects of Light Water Reactors A. Busbar Cost 1. Construction Cost 2. Operation and Maintenance Costs 3. Fuel Costs B. Operating Capacity 1. Availability Factor 2. Capacity Factor

Figure 14. An outline for which note-taking is partially complete

In the final step in notetaking, you arrange the notecards in the order that you'll use them as you write the rough draft. Read through your cards several times to make sure the sequence is right and that there are no gaps in the information you've gathered. When you're sure that the order is right, write sequence numbers on each of the cards to preserve the order (see the sequence numbers on the notecards in the next section). With the notecards in the right order and numbered, you are ready to write the first draft, which is discussed in the section on rough drafting.

Other systems of notetaking

There are plenty of other ways to take notes. The main point of any form of note-taking of course is to make your report work easier and less time-consuming. You may prefer some other note-taking system because of your own work style or because of your report project. Or, you may end up using some other system in combination with the traditional one. Any system that enables you to get your work done efficiently is a good one.

- Mental notetaking. With short reports, it is possible to remember all the information and not writing any of it down is possible. But few of us are able to remember all of the information for long, highly technical reports.
- Book marks. If you use only a few articles or books, you can mark the important passages with slips of paper and write the rough draft with them. If you have many books and articles, this approach can get to be quite chaotic.
- Photocopying. You can also photocopy everything you think you need in your report. With the photocopied pages, you highlight the important passages, or cut out the important passages and paste them on notecards. Two problems with this approach are that (a) you may photocopy many unnecessary pages and waste money and (b) you still have the job of paraphrasing and summarizing ahead of you. Still, this is a system some report writers use occasionally to supplement their more traditional note-taking procedures.
- Exploratory drafts. If you are already familiar with your report subject, you can try writing a rough skeletal draft to show you what information you need. You may discover that all you lack is specific names, statistics, or terminology. You can take

notes and plug the information into the draft (especially if you have computerized word processing). Writing the exploratory draft shows you what you know and don't know.

- Notetaking by the source. If you have only a few sources, you can also use one other fairly common system of notetaking:
    1. You take notes from individual sources onto long sheets of paper rather than onto notecards.
    2. You take all the information you need from the source onto as many sheets of paper as necessary; you don't split it up into bits of information on separate notecards.
    3. At the top of each notesheet, you give full bibliographic information on the book or article.
    4. Throughout each notesheet, you indicate the exact pages the information comes from.
    5. Also, you label these pages of notes with locators, the letter-number combinations from the outline.
    6. You mark off sections of the outline as you gather sufficient information for them.
    7. In some cases, you can cut up these full-page notes and actually handle them as if they were notecards. Here is an example sheet of notes using this approach:

Outline Source: J Pages area 1. BWR core—large nbr of fuel assembls (94) ea one a sq array 7 X 7 or 8 X 8 III,A,1 fuel pin: active length 12 ft contains water rod (providg (95) moderator w/in f bundles) III,A,2 large BWR contains 764 assems w 40-50,000 f rods + about 180 tons of uran. diox 2. reactor vessel—contains core (99-100) and assoc equip, also control rods above core, steam separators/dryers 3. vessel dimensions: 72 ft high, 21 ft diam (100) material: carbon steel, 6-7 in thick III,A,3 clad w 1/8 in stainls steel withstands 1000 psi at operatg temps 4. coolant—recirculates w/in react vessel of BWR IV,B,2-3 no external loop jet pumps in annulus (101) pump: reactor inlet nozzles

Figure 15. Sample notesheet: taking notes by the source

In this system, the source (book, article, report, etc.) is indicated at the top of the page; the page numbers are indicated down the right margin in parentheses; and the sheet of notes is keyed to the outline down the left margin in parentheses.