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on Preparing

a Scientific

Research Paper

Sea Grant
Woods Hole

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Tips on Preparing a Scientific Research Paper

from the Sea Grant Program
of the
Woods Hole Oceanographic Institution (WHOI)

Sometimes, the hardest part of any assignment is getting started. This is especially true for research projects because there are several steps involved: deciding on the right topic, gathering sources of information, putting it all together, and finally, writing the paper.

The following tips were prepared by the Sea Grant Program at the Woods Hole Oceanographic Institution (WHOI), with the help of researchers, librarians, and teachers, to help you organize your research paper from beginning to end. While putting it off to the last minute may sound like a good idea when the teacher assigns the project, procrastination never makes the project easier to complete! Fear not. Read through these tips, take it step-by-step and week-by-week, and you'll be finished before you know it.

Understanding Your Assignment, Plotting a Course of Action
How to start, Where to Start

Most likely, you know which classes require research papers or science projects ahead of time. Getting the assignment should not come as a big

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surprise. Perhaps you've been thinking about a topic, or maybe you've been putting that off, hoping the teacher might, somehow, forget to assign that 20-page research paper this semester. In any case, the time has come; the decree has been issued: *you shall write a research paper.*

One of the first things to do is think about the time frame you're dealing with. Do you have two weeks to complete the assignment? Four weeks? Six weeks? Will you need to submit an outline at some point? *Plan ahead!* Most likely, your other homework assignments, after school activities, and weekend plans won't stop just because you're working on a research paper. Look at a calendar: mark the date that the paper is due, along with any other deadlines associated with the project. It's not a bad idea to write down other dates, including any other large assignments, tests, or events that will require some of your time.

Identifying Topics of Interest

You've received your assignment and consulted a calendar, now it's time to choose a topic for your research paper. Choose something that fits the assignment, yet interests you. Chances are, by the time you finish this project, you'll be an expert on your subject. Make it something you'll enjoy researching and educating others about.

While your freedom to choose a topic may or may not be unlimited, remember that a large part of this assignment involves research. Finding references and resources for a very specific or unusual topic may be a lot more time-consuming than a popular subject. On the other hand, choosing a topic that is too broad or general could result in a paper that doesn't have a strong focus.

Your best bet may be selecting a few topics or subjects that you think may result in an interesting and informative paper and do a bit of preliminary research. A quick card catalog or computer search at your school or public library will give you a good indication as to whether references and supporting materials are readily available. This also could help you narrow down your choices: if no references come up, or very few, this may be a difficult subject to work on. Conversely, if tens or hundreds of references come up, you may want to narrow the topic down to something more specific.

What Do You Want to Say about Your Topic?

Once you've selected your topic, the next consideration is what to say about the topic. Your goals: find out all you can about your topic and prepare a paper that educates readers about the subject.

One way to decide what to say about your topic is to consider what you'd like to know about your subject. Is there anything that intrigues you about your topic? Is there anything controversial about your topic that could be explored? Are there pros and cons to your topic that could be compared and contrasted? Are there trends or events that might impact your topic in the future or that may have impacted your subject in the past? Having an angle or a hypothesis may also result in more references and resources for your paper.

Outlining Your Project

Now that you have your topic selected, and you've given thought to what ideas you'd like to present about your topic, it's time to prepare an

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outline. This is important to do, even if you are not required to turn in an outline as part of the assignment. An outline will be very useful later, as you begin your research and reference collecting. It will be a handy reference tool to keep you focused on the goals you'd like to accomplish with the project. By creating an outline early in the process, you will be able to envision the finished product and the steps you need to take to reach that goal.

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Once you've gotten further into your research, you may find that what you originally wanted to say in your paper is not relevant, or is less interesting than you'd expected. Don't panic! This happens often, and proves the value of good organization and time management. Outlines are easy to revise—much easier than re-writing large sections of a research paper!

When writing an outline include everything, from your subject and hypothesis or theme to the main points you hope to make, to the bibliography. By doing so, you'll be able to see which areas need research.

Outlines are very useful when you reach the writing stage. Faced with piles of references, which can include books, articles, notes, and quotes, you'll be glad you wrote an outline! Referring to your outline will help you organize your notes and references by section or, for example, by points you'll be making in your paper. That way, when it's time to pull it all together and get down to writing, your references and notes will be organized and easy to find.

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Compiling Resources

Once you've got your outline together, it's time to start researching your subject. This can be another intimidating part of preparing a research paper. In many cases, it is the most time-consuming part of the project, so plan accordingly. Also, be prepared for the fact that your school or local library may not have everything you need on your subject. In some cases, you may have to get books or publications from other libraries, or you may have to write away for information. Allow time for this!

Teacher/Classroom resources

When assigning research papers or projects, some teachers may provide a list of references or resources for you to work from. Even if that is the case, these references will not, in most cases, be the only resources you'll need. Be prepared to do some searching in other places. Your teacher is a great starting point. Because teachers have had experience assigning—and preparing—research projects in the past, they are probably familiar with other, local resources. Check with your teacher early so that he or she has time to provide you with some information and that you have enough time to contact these sources. Also, your teacher may have reference books in the classroom that could be used during a free period, during lunch, or after school.

Ask your librarian for help!

Never underestimate the knowledge of your librarian! Remember, librarians know their collections—they are familiar with the types of reference books, periodicals, and other resources in their library and are usually more than happy to help you locate resources and get you acquainted

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with the library. Aside from your school or public library, there may be colleges or universities nearby. Sometimes, local companies have their own in-house libraries or research libraries. While such libraries may require special permission to access or borrow materials, they are definitely worth contacting. In many cases, the variety, selection, and collections of materials are more current or extensive than community or school libraries. Before you set out for these libraries, it's best to call ahead to find out their business hours and borrowing policies.

Once you're at a library, be adventurous! Encyclopedias may be useful for general information about a subject, but they are often outdated or too vague for a research paper. Try out the card catalog or on-line computer catalog and search it by subject. Once you come up with a list of references, hit the stacks! One book or periodical may lead to additional references that you would not have found through a card catalog or computer search. If you come up with an author that seems to have published more than one item on your subject, try a computer search by the author's name. Title searches are helpful if you're looking for a publication that you've used before or that someone has recommended to you.

Reference materials are another important resource. In most cases, reference materials cannot be checked out of a library, although you are free to use them while you're there and photocopy pages that you'd like to study later. With all references, be sure to jot down the relevant end note or footnote information if you'll be referencing any of the material in your paper. This is impor-

tant to do whether you'll be paraphrasing, quoting, or just referring to the information. For help creating accurate end notes or footnotes, refer to the citation resources listed at the end of this publication. These sources include guidance for citing on-line sources, software, CD-ROMs, and more.

While books, periodicals, and library reference materials may be the most common resources for research papers, there are other sources that may prove just as useful. Videos are one example. Libraries are a good source of videos, as are professional organizations that specialize in a subject area. If your school has a media specialist, ask them if they receive video catalogs that you could take a look at. Also, television channels such as Discovery, The Learning Channel, and public broadcasting channels, as well as special cable programs, such as Nova, often list their upcoming programs in publications for school media professionals. Such programs are also good resources.

Another excellent source of information is CD-ROMs. Aside from excellent, up-to-date encyclopedias, dictionaries and thesauruses, there are now CD-ROMs available on many specific topics. Check your school or community library, or check with your school's computing instructor. Many computer supply magazines also carry educational CD-ROMs.

On-line Searches

With the growing popularity and availability of on-line computer networks, conducting literature searches on a school, library, or home computer is another excellent way to identify resources and

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references on your subject. The Internet, for example, can bring information to your computer terminal from throughout the world. There are a number of software programs that have been developed specifically for conducting on-line searches, called "browsers." These operate in much the same way a card catalog or library computer searches — by subject, title, author, or key word. Check with your teacher or school computer expert, or ask your school or public librarian if they offer such capabilities. *A word about on-line sources of information:* it can be difficult to determine the accuracy of information accessed on-line. As with published reference material, be sure to include the URL (Uniform Resource Locator), and date of any on-line material you refer to in your paper (see the citation resources at the end of this publication for details). An example of a URL is: http://www.whoi.edu/seagrant/.

Organizations to Contact

If your teacher recommends calling local "experts" or organizations, keep this in mind: professionals are very busy doing their jobs. While they may be more than willing to help you with your project, it is important to know your subject before you contact them. Once you're familiar with the subject and feel comfortable talking about it, jot down some questions that they might be able to answer. Being prepared **before** contacting a professional will show them that you are organized and interested in the subject. Ask a few specific questions and ask them to explain something if you don't understand what they are saying. It's OK to ask questions if you've done your homework, but don't expect the experts to do your assignment for you! You may also want

to ask if they can recommend any books, publications, or other organizations to contact. Sometimes the best way to find good resources is to ask good sources!

Organizing Your Resources
How much is Enough?
One of the more difficult aspects of collecting references and resources for your paper is deciding when you've got enough. A good rule of thumb is to ask yourself, do I have enough material to support my main points? This is a good time to refer to your outline and go through each point that you wanted to make in your paper. Based on your research and supporting references, can you make those points and back them up with facts and/or examples? Chances are, you'll have more than enough information for some of your points and not enough for others. Identify the places where you are lacking references, and head back to the library. This time around, collecting the necessary references should be much quicker since you've identified specific areas to address.

Once you're comfortable with your resources and feel you've got enough information to write your paper and present your subject thoroughly, it's time to organize! Now is the time to group all of the information you've collected by category or main points. Keep these piles separate and mark or label them by section or category. An easy way to do this is to refer to your outline and assign each section a number or letter and mark your piles of information the same way.

Based on the research you've done and the information you've gathered, check your outline to see if it needs to be revised. Be sure that your

"A good rule of thumb is to ask yourself, do I have enough material to support my main points?"

points match your supporting materials. Take the time to do this now, before you start writing. Lastly, be sure you have recorded all of the relevant information for referencing resources in your report. And, when in doubt, cite the source for something that may not be 100% original!

Preparing the Paper or Project

Mental Preparation

Now that you've made it this far, you might think that writing or typing your paper will be a snap! Often, this is not the case. A sense of anxiety or "writer's block" can slow down even the most organized! There are a couple of tips that should help get you into the writing frame-of-mind. Once you've finished that first paragraph or two, things begin to get easier. Really.

For starters, re-visit original questions, hypotheses, and ideas to stimulate your thought process. Remind yourself that you have worked hard to gather good resources and references to back up these questions, hypotheses, and ideas. Think about the things that you've learned about your subject while researching it and what you'd like to share with others to educate them about this subject you know so well.

Are you feeling confident yet?

Expand on Your Outline

Before actually beginning to write the research paper, some people find it helpful to expand on their outline. Basically, this involves adding a sentence or two under the headings or main points to summarize the points you will make. Jotting notes in the margins about which references you will cite may also be helpful.

it's brief. Remember how frustrating it was when you came across a good source of information on your subject but discovered it was written at too technical a level. Don't frustrate your reader by doing the same thing! When in doubt, put a note next to a paragraph that may be too technical or difficult to understand and ask a friend or a parent to read it. Chances are, they'll be able to tell you whether or not you should explain it in more detail.

Once you've finished writing—or even as you're writing—take an occasional look at what you've written. Does the paper flow logically from one section to the next? If not, you may want to work on a smoother "transition." Basically, this means adding a transitional phrase or sentence at the beginning of a section that takes the reader from your last point to your next point without stopping abruptly. If you're having trouble, check with your English teacher or have a friend or parent offer suggestions. Sometimes the problem is that you're just too familiar with the subject to be objective!

Another thing to look out for while you're writing is clarity. Write what you mean. Don't get carried away with large words or flowery vocabulary. Be direct. Remember, you're educating your audience. Leave out or delete sections that get away from your main points. Try not to be overly concerned with numbers of pages. A well-written paper containing strong points that have been supported by references—even if it's a page or two shorter than what your teacher may have asked for—will read better (and most likely, receive a better grade) than a poorly organized,

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Other people may decide to skip this process and start writing. Do whatever feels more comfortable to you. Perhaps you tried to start writing and got stuck. Try expanding on your outline and you may find yourself writing your paper by point number two. You've done your homework; whether or not you jump into the actual paper writing or decide to expand your outline does not matter. Your paper is almost finished!

Make your research work for you

With all of the research you've done, make sure you present your references in a way that shows you've done your homework. Also be sure that your voice comes through in your writing. While it's important to have references to back up your main points, you don't want so many that your paper seems like one long quotation from books and articles!

How do your resources and reference materials support your objectives, ideas, and hypothesis? This should be clear to the reader. Backing up one of your strong points with a weak reference or quotation will disappoint your reader and water down your argument. You collected your references because they supported your ideas—make sure that you convey this to your readers!

Write clearly and logically

This is very important. Write as if you are explaining what you've learned to someone who knows nothing about your topic; do not assume your reader has any prior knowledge of your subject matter. While you don't want to over-simplify, a thorough explanation of some of your main points and ideas—since they may not be familiar to your reader—warrant an explanation, even if

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sloppily referenced paper that fills pages with unimportant information.

Reviewing Your Paper or Project

You've reached the final step: reviewing your finished product. Try to avoid doing this right after you've finished writing your paper. Take a break or wait until the next day, if you have enough time. It's a good idea to put some time between writing and reviewing your work. That way, you can clear your mind from the organizing, compiling, writing, referencing mode and be more objective when you go back and read your paper from beginning to end.

Once you feel ready to review your work, the kinds of things to look for should be similar to the goals and objectives included in your outline. Have you covered the areas you'd hoped to? Have you answered your original questions and objectives? Have you conveyed knowledge and information that's easy to follow? Do you feel confident that you've learned something about your subject that will interest others? Are the things you learned and found most interesting about your subject included in your paper?

More obvious things to look for when you review your work are grammar and appearance. Check for misspellings or typos, proper punctuation and spacing, page numbering, and proper construction of footnotes, end notes or a reference section. Now that you've invested so much time and energy in this project, you want to make sure it looks as good as the information contained within your paragraphs!

At this point, you should congratulate yourself!

Checklist:

Have you covered what you hoped to?

Have you answered your orginal questions?

Is your information easy to follow?

Have you learned something that will interest others?

Does your paper include what you found most interesting about your topic?

Have you reviewed the paper for spelling and grammar?

Have you properly cited all references and resources?

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Barring any unforeseen calamities, such as the dog eating your paper or dropping it in a puddle on the way to school, you're nearly home free. This is a good time to evaluate your paper preparation experience. What would you do differently the next time? Research projects are often easier to do with some prior experience. For now, reward yourself for all of your hard work by doing something you really enjoy — and don't forget to return any borrowed books, magazines, or other reference materials you checked out of the library or borrowed from other sources. If you received help or advice from a professional, it's always nice to send a thank you note.

—Tracey I. Crago, Communicator
WHOI Sea Grant Program

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