

**Guidelines for Best
Practices:
How Do We Reach
Low-Literacy
Audiences?**



Guidelines for Best Practices: How Do We Reach Low-Literacy Audiences?

Written by Fiona Doherty, Extension Support Specialist at Cornell University

Reviewed by Marcia Eames-Sheavly, Senior Extension Associate and Senior Lecturer at Cornell University

Published in February 2019

Funded by The New York State Integrated Pest Management Program

Acknowledgements

A special thank you to the following individuals who contributed to the project through interviews, sharing resources and general support.

Funding: The New York State Integrated Pest Management Program

Co-lead: Marcia Eames-Sheavly, Senior Extension Associate and Senior Lecturer in the Section of Integrative Plant Science

Cover Photograph by: Jay Potter, Graphic Designer at Cornell Botanic Gardens

Contributors:

Sharon Bachman, Agriculture and Natural Resources Educator at CCE Erie

Mary Lee Bourbeau, Director of Finger Lakes Eat Smart at CCE Wayne

Lori Brewer, Senior Extension Associate at Cornell Garden-Based Learning

Annie Christian Reuter, Project Coordinator at Cornell Garden-Based Learning

Donna Alese Cooke, Community Horticulture Specialist at CCE Suffolk

Chrys Gardener, Community Horticulture Educator at CCE Tompkins

Linda Gilliland, Quality of Life Issue Leader at CCE Essex

Christine Hadekel, Statewide Education and Outreach Manager at Oregon Food Bank

Mark Miller, Outreach Education Manager at Franklin Park Conservatory & Botanical Gardens

Joan Paddock, Senior Extension Associate at Cornell University Division of Nutritional Sciences

Michelle Podolec, Project Coordinator at Cornell University Yang-Tan Institute

Jenny Pope, Director of Community Outreach & Education at Franklin Park Conservatory & Botanical Gardens

Steve Reiners, Professor and Chair of the Cornell University Section of Integrative Plant Science

Guilaine Senecal, Assistant Director Cornell University Office of Research Integrity and Assurance

Jamila Simon, NYS 4-H Civic Engagement Specialist at Cornell University



Cornell Cooperative Extension

Cornell CALS
College of Agriculture and Life Sciences

Table of Contents:

- 1. Introduction ... page 5**
- 2. What is low-literacy? ...page 6**
- 3. What does low-literacy look like in NYS? ...page 8**
- 4. What are the impacts of low-literacy? ...page 9**
- 5. Theory that can ground our work ...page 10**
- 6. Question our assumptions ...page 12**
- 7. Develop suitable materials ...page 13**
 - Common shortcomings
 - Important definitions to consider
 - Process of planning for written materials
 - Guidelines for writing
 - Strategies for writing web content
 - Strategies for creating audio content
 - Strategies for translating materials
- 8. Testing materials ...page 19**
 - Readability Tests
 - Seeking target audience input
- 9. A Case-Study: Adapting Garden-Based Learning resources ...page 23**
- 10. Conclusion ...page 25**
- 11. Glossary of Terms ...page 26**
- 12. Learn More ...page 27**
- 13. References ...page 28**
- Appendices ...page 29**
 - A. Sample Planning Checklist ...page 30
 - B. Planning Checklist Template...page 32
 - C. Directions for the Fry Reading Formula...page 33
 - D. Focus Group Session Outline Template...page 35
 - E. Cornell Garden-Based Learning Case Study Resource Revisions...page 37

1. Introduction

According to *The New England Journal of Medicine* (Marcus, 2006), 12 percent of U.S. adults are estimated to have below basic “document literacy,” meaning they lack the ability to read and understand documents and labels. Low-literacy audiences may face many overwhelming challenges: poverty, unemployment, food insecurity, and the deep shame that undergirds these issues. It is difficult for this demographic to find accessible resources, including horticulture and IPM education. As our program increasingly meets the needs of low-income gardeners, we are learning that this marginalized community lacks even the most basic resources to properly participate in food gardening projects. Furthermore, without being able to read and understand documents, labels, directions and the basics of ecological gardening, it is highly likely they carry out improper horticultural product practices which could be detrimental to our environment – and to themselves and their families.

The following guidelines have been developed in an effort to streamline best practices of engaging this priority audience. Information was gathered from stakeholder interviews, focus groups and extensive research of relevant materials. Thank you to NYS IPM for providing funds for the project.

An important note for readers: We acknowledge that we have used many words in this document while talking about strategies to decrease wordiness. We recognize the irony of this and yet, a set of guidelines for best practices was selected as a preferred method for our target audience of educators. We encourage you to review the Table of Contents and choose the areas that call to you rather than reading through the entire document in one sitting.

2. What is low-literacy?

Table 1: Levels of Literacy (“Plain Language,” 2005)

Literacy is an individual's ability to read, write, and speak in English and compute and solve problems at levels of proficiency necessary to function on the job and in society, to achieve one's goals, and to develop one's knowledge and potential.
Low literacy is a <i>limited</i> ability to do what is defined above as literacy.
Illiteracy means being unable to read or write.

This project focuses on efforts to engage those who have difficulty reading; however, several other elements may impact reading comprehension:

Table 2: Other Elements that May Impact Reading Comprehension

English as a Second Language: Those for whom English is not a primary language. Individuals in this population may be fluent in English, may know some English or may not know any English at all. Materials developed for low-literacy audiences will likely meet some of their same needs as well.
Visual Information Processing Issues: A visual processing, or perceptual, disorder refers to a hindered ability to make sense of information taken in through the eyes. This is different from problems involving sight or sharpness of vision. Difficulties with visual processing affect how visual information is interpreted, or processed by the brain. Enlarged print and simpler materials help accommodate this population (“National Center for Learning Disabilities,” 2018).
Age-Related Eye Diseases and Conditions: As a greater percent of our population begins to age, vision conditions related to aging will rise dramatically.

Science Literacy: The knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity (“National Science Education Standards,” 1998). If someone lacks science literacy then they will be unlikely to decipher complex horticulture information.

Age of Post-Literacy: We are entering a time in which literacy is no longer necessary or valued by society (“Collins Dictionary Site,” 2018), in which everyone is pressed for time and wants instant, concise, and convenient information.

We can deduce from these definitions that efforts to streamline and simplify educational materials is not only relevant to lower-literacy audiences but to our entire population. Though children and youth are not included in the above table, efforts to simplify educational materials will also benefit them.

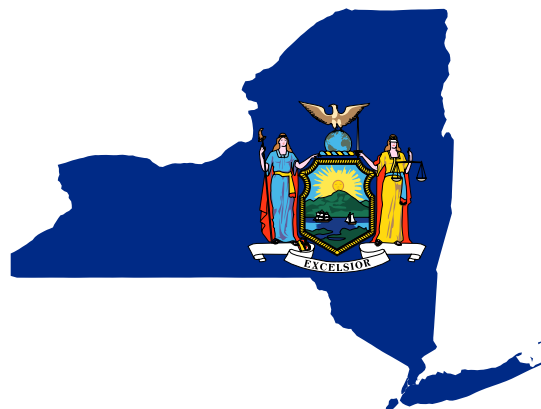


3. What does low-literacy look like in NYS?

Someone might wonder, “why does this matter, I’ve never met someone who cannot read.” However, lower-literacy individuals are often proficient in disguising their inability to read. They may use terms like “I forgot my glasses” or “I’ll take this home to read it later.” Teenaged youth who cannot read may act-out when put in a situation that requires them to read, overshadowing their reading inability with a behavioral issue. We have all likely interacted with a person who cannot read and we did not realize it at the time.

According to the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2003 National Assessment of Adult Literacy, **22% of NYS residents lack basic prose literacy skills.** (Note, you can look up your specific county by going to this website, <https://nces.ed.gov/naal/estimates/StateEstimates.aspx>). **Prose literacy** is defined as the knowledge and skills needed to perform prose tasks, (i.e., to search, comprehend, and use continuous texts). Examples include editorials, news stories, brochures, and instructional materials (“National Center for Education Statistics,” 2003).

As such, if you offer a workshop to 20 people, it is possible that 4 or 5 of them could have difficulty reading. That is a substantial portion of the group that you will likely miss engaging if you rely on text-heavy materials.



4. What are the impacts of being low-literacy?

Table 3: Differences between good and poor readers- and how you can manage the problems

Skilled Readers	Poor Readers	Managing the problems
<ul style="list-style-type: none">• Interpret meaning	<ul style="list-style-type: none">• Take words literally	<ul style="list-style-type: none">• Explain the meaning
<ul style="list-style-type: none">• Read with fluency	<ul style="list-style-type: none">• Read slowly, miss meaning	<ul style="list-style-type: none">• Use common words, examples
<ul style="list-style-type: none">• Get help for uncommon word	<ul style="list-style-type: none">• Skip over the word	<ul style="list-style-type: none">• Use examples, review
<ul style="list-style-type: none">• Grasp the context	<ul style="list-style-type: none">• Miss the context	<ul style="list-style-type: none">• Tell context first, use visuals
<ul style="list-style-type: none">• Persistent readers	<ul style="list-style-type: none">• Tire quickly	<ul style="list-style-type: none">• Short segments, easy layout

As demonstrated in Table 3 (Conrath Doak, 1996), lower-literacy individuals may misinterpret or skip over key information, or give up if the information is not accessible to them. Without being able to understand documents, labels or directions, it is highly likely they carry out improper horticultural product practices that could be detrimental to the environment – and to themselves and their families.

What we consider to be a basic factsheet or webpage is often wordy and overwhelming to someone who has difficulty reading. As such, our main way of sharing information is irrelevant and inaccessible to a portion of the community and we are missing valuable connections that could improve food security and ecological stewardship.

Thankfully, there are steps we can take to develop suitable materials that are inclusive to not only lower-literacy audiences but to those who may have processing issues, aging eyes, low science literacy or those who are short on time and want clear information in a hurry.

5. Theory that can ground our work

5a. Adult Learning Theory

It is important to be aware of how adults learn best. Based on scholarly studies, there are several assumptions we can make about adult learners (Groen & Kawalilak, 2014).

Adults:

- Are experts of their lived experience
- Are goal oriented
- Are self-directed with internal motivations
- Want to be involved in the learning process
- Give and receive information
- Need safety, trust and accountability in a learning environment

Q: How can we integrate adult learning theory into our work?

A: When developing information, we can tailor it in a way that honors the principles of adult learning.

Adult Learning Theory Checklist

- Is the information meaningful and relevant to users?
- Is the information organized in a way that is accessible to users?
- Is the information action-oriented?
- Are users able to interact with the information or be involved in the learning process?
- Is it clear how the user can apply the information?



5b. Self-Efficacy Theory

Self-efficacy refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (American Psychological Association, n.d.).

Q: How does self-efficacy relate to engaging audiences in horticultural education?

A: If individuals are overwhelmed by material or if the material is not presented in a way that is understandable, they will not feel confident in adapting new behaviors.

Q: How can we increase self-efficacy within our audiences?

A: Present information in a way that the tasks seem doable. Complex tasks can be split into several smaller, simpler tasks, giving readers the sense of several successes after they achieve each one (Conrath Doak, 1996).



6. Question our assumptions

Before we jump into developing suitable materials, it is important to consider some assumptions.

Table 4: Take some time to reflect on assumptions you may have made

Assumptions	Your Thoughts & Notes
<ul style="list-style-type: none"><input type="checkbox"/> Everyone in your workshop, browsing your website or reviewing your factsheet can read.<input type="checkbox"/> Everyone in your workshop, browsing your website or reviewing your factsheet can read at the same level.<input type="checkbox"/> Everyone in your workshop, browsing your website or reviewing your factsheet can understand scientific language.<input type="checkbox"/> Everyone in your workshop, browsing your website or reviewing your factsheet is comfortable reading out loud.<input type="checkbox"/> Everyone in your workshop cares about the background materials and scientific foundations of basic content.<input type="checkbox"/> Individuals who cannot read will tell you.<input type="checkbox"/> Individuals who cannot read will ask for help.<input type="checkbox"/> Individuals who cannot read are ignorant and learn slowly.<input type="checkbox"/> Individuals who cannot read are impoverished, immigrants or minorities.<input type="checkbox"/> Written information is more valuable than spoken information.<input type="checkbox"/> If we simplify materials, then literate audiences will find them too elementary or basic; they will not take them seriously.	

Have you made any of the above assumptions? How have they impacted your engagement with community members? How might you change your behavior in the future?



7. Develop suitable materials

7a. Common Shortcomings

As we begin to outline the process of developing suitable materials, let us first identify some common shortcomings between educational materials and readers.

Table 5: Common shortcomings between materials and readers (Conrath Doak, 1996)

Shortcoming	Best Practice
Too much information is included. This discourages poor readers and tends to obscure the priority information for all readers.	Pick one or two main messages you wish to communicate.
Readability levels are too high for the average person.	Use short sentences and plain language.
The material is not made relevant to readers. There is no clear indication of why it matters or how it applies to them.	Start by grounding readers in the significance of the information.
The reader is not asked to interact with the material and, as a result, the opportunity for deeper learning and recall is lost.	Use multiple methods of engagement including simple text, images and reflective questions.
Difficult or uncommon words are not explained or supported with examples.	Clearly define complex words and define, reduce (or eliminate) jargon. Use plain language in the definitions so readers do not have to look up additional words.



7b. Two Important Definitions to Consider

Plain language is defined as “Writing that is clear, concise, well-organized, and follows other best practices appropriate to the subject or field and intended audience” (The Plain Writing Act, 2010). The Plain Writing Act was passed in 2010, the law requires that federal agencies use clear government communication that the public can understand and use.

- www.Plainlanguage.gov has organized techniques to help develop communications in plain language.
- The Center for Plain Language has developed a “Federal Plain Language Report Card” that grades several governmental agency websites based on plain language (Center for Plain Language, 2018). Please explore the Department of Agriculture website (<https://www.usda.gov/>), which received an A-, and compare it to the Department Housing and Urban Development (<https://www.hud.gov/>), which received a D. What differences do you see?

Readability measures word difficulty and sentence length. The more multi-syllable words, and the longer the sentences, the greater difficulty (Conrath Doak, 1996).



7c. Process of planning

Now that we've identified some common shortcomings and key definitions, let's tackle the process of planning for written materials.

Planning Checklist (Conrath Doak, 1996)

- **Define and involve the audience**
 - Ages, genders, cultures
 - Literacy levels and readiness to learn
 - Include a few community members in the planning phases. Involve target audience in materials design. For example, through focus groups, surveys or interviews.
- **Limit the objective(s) and the message**
 - Decide on the minimum educational objective. For example, proper pesticide use.
 - List topics that *must* be included.
- **Writing and production phases**
 - Select format(s): factsheet, web-based resource, audio, video, etc.
 - Decide how to include interaction.
 - Decide which words or phrases need explanatory examples and include them. (Sometimes a healthy soil can be dark in color like chocolate cookie batter).
- **Quality Assurance**
 - Plan to test the draft and the final with a few community members from the target audience
 - Use readability tests and checklists, learn more on page 19.
 - Document the assessment results.

Find the Sample Planning Checklist and Planning Checklist Template in Appendix A.



7d. Guidelines for Writing (Conrath Doak, 1996 and Federal Plain Language Guidelines, 2011)

- **Use active voice.**
 - Active: Read fertilizer directions carefully.
 - Passive: Fertilizer directions should be read carefully.

 - Active: Call your local Cooperative Extension office.
 - Passive: Your local Cooperative Extension office should be called.

 - Active: Ask your local Cooperative Extension office for assistance.
 - Passive: Assistance will be provided by your local Cooperative Extension office.

- **Address one person, not a group.**
 - Group: Individuals and organizations wanting to seek information...
 - Individual: If you want information...

 - Impersonal: The inquirer should call their local extension office.
 - Singular and personal: You should call your local extension office.

- **Use common words and short sentences. Use the simplest form of a verb.**
 - Complex: Beneficial insects provide great services for ecosystems.
 - Simple and short: Good bugs help plants.

 - Complex: Pesticide misuse can be detrimental to both the applicator and the environment.
 - Simple and short: Mistakes with pesticides can harm people and plants.

- **Use the same term consistently for a specific thought or object.**
 - For example, if you use the term “pesticides,” do not refer to it later as “sprays.”

- **Give examples to explain difficult concepts and words.**

- **Include interaction and repetition.** For example:
 - Write a question and leave a blank space for the reader to write or draw a response.
 - Provide examples of images and ask the reader to circle the correct choice.
 - Pose a problem and ask the reader to draw or say out loud how it could be solved.
 - Ask the reader to demonstrate what was read.
 - Pose a reflective question at the end of the material.
 - If individuals have no reading capability, provide the materials in an audio-format. See more on audio content on page 18.

- **Formatting tactics:**

- Use headings in underlined or bold print to organize information. When in doubt, use more headings. Make heading titles clear and short.
- Include key information first.
- Include information relevance and context early.
- Use a box with larger font to highlight the most important information.
- Write short paragraphs and sections, covering only one topic in each.
- Minimize abbreviations, acronyms, jargon and technical terms.
- Don't use slashes. For example, "and/or."
- Use serif type in 12-point font or larger.

- **Serif typefaces** use marks to embellish characters, making them easier to read.
- Serif fonts include: Times New Roman, Garamond, Georgia, Palatino and Cambria.
- Sans-serif fonts are more difficult to read and include: Arial, Calibri, Helvetica, Lucida Sans and Tahoma. For accessibility purposes, avoid using these fonts.

- Use ***bold and italics*** to make important concepts stand out.
- Avoid ALL CAPS.
- Aim to limit line length to 30-50 characters and spaces.
- Make the left edge of lines align.
- Include plenty of white space.
- Make the page look like it can be read in just a few minutes, viewers will be more likely to read it.
- Ask a colleague or friend to review your work through these lenses.

- **Other strategies:**

- Simple and short vertical lists help highlight information in a clear way.
- Tables help readers understand relationships that may be hidden in dense text. They also break up the document and create space which is easier on the eye.
- Illustrations, images and graphics. Relevant and clear illustrations or graphics are exceptionally helpful. Visual presentations have been shown to be more persuasive than unaided presentations (Conrath Doak, 1996). Visuals help viewers remember information more effectively. When using visuals:
 - Make sure the viewer can identify with the visual and that it is relevant to them.
 - Make sure the message or behavior action is clear.



7e. Strategies for Writing Web Content (Federal Plain Language Guidelines, 2011)

Research tells us the following:

- Web users only use about 18% of what is on one page. As the number of words goes up, the percentage read goes down. For viewers to read half of your words, try to limit your webpage to 110 words or fewer.
- Web users scan the webpage in an “F” pattern and decide in as little as five seconds if the website is relevant to them. Clearly identify the mission or purpose of the website near the top-left of the page.
- Follow the same plain language guidelines that are stated above.
- Avoid posting many PDF files, they can be slow to open and can make viewers lose the website if they open in the same window.
- Use effective link names that are short, meaningful and clear. Do not use “click here” or “more.”

7f. Strategies for Creating Audio Content

- Adults who have lower literacy skills, and no hearing impairment or audio processing issues, can understand audio content at a higher rate than the same written content (Conrath Doak, 1996).
- Audio content uses more common language and conveys emotion, making it easier to understand.
- Keep audio content in short segments, 10 minutes or shorter.
- Follow the same plain language strategies when developing audio content. Use the planning checklist on page 15.

7g. Strategies for Translating Materials

- When translating materials into a different language, it is important to work with members from your target audience, ideally who understand and relate to the horticultural content. For example, when working with a Dominican population, hire a Dominican translator, or when working with a Puerto Rican population, hire a Puerto Rican translator. Both groups speak Spanish but there are subtle, nuanced differences between each region’s dialect. Translating materials into the appropriate dialect is important.
- For some key terms, you are doing your audience a disservice by translating. For example, it may be better to define the term “shovel” rather than translate it. That way, when they go to their local garden center, they know to ask for a “shovel.”



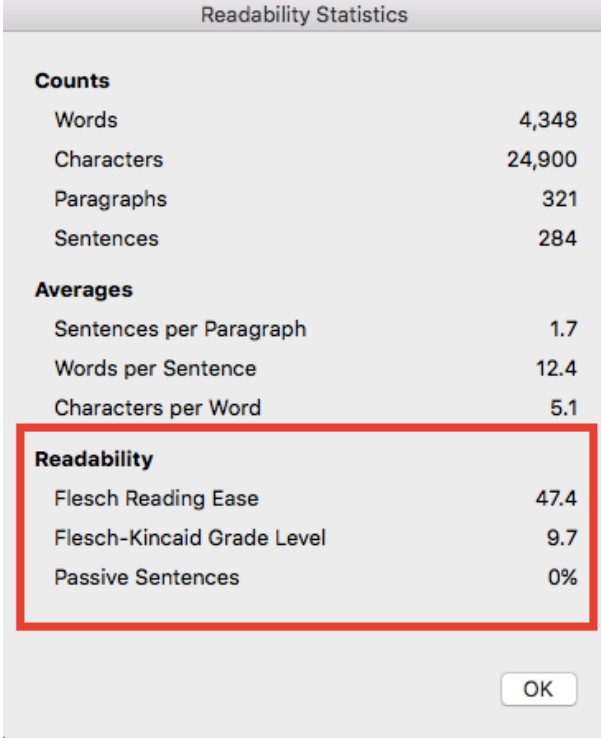
8. Testing materials

8a. Readability Tests

As defined on page 14, readability measures word difficulty and sentence length. The more multi-syllable words, and the longer the sentences, the greater difficulty Conrath Doak, 1996). There are several tests we can use to test readability even before we seek target audience input.

Microsoft Word has an easy-to-use, built in readability test tool that provides both the Flesch Reading Ease and the Flesch-Kincaid Grade Level, as shown in Figure 1. The Flesch Reading Ease and Flesch-Kincaid Grade Level are two common readability tests. With the Flesch Reading Ease, a higher score shows that the materials are easier to read. The Flesch-Kincaid Grade Level shows a score that corresponds to a US grade level, as shown in Table 6.

Figure 1: Microsoft Word Readability Statistics



Readability Statistics	
Counts	
Words	4,348
Characters	24,900
Paragraphs	321
Sentences	284
Averages	
Sentences per Paragraph	1.7
Words per Sentence	12.4
Characters per Word	5.1
Readability	
Flesch Reading Ease	47.4
Flesch-Kincaid Grade Level	9.7
Passive Sentences	0%

Table 6: *Flesh Reading and Flesh-Kincaid Grade Level Score Interpretations* (Wikipedia, n.d.).

Score	School Level	Notes
90.0–100.0	5th grade	Very easy to read. Easily understood by an average 11-year-old student.
80.0–90.0	6th grade	Easy to read. Conversational English for consumers.
70.0–80.0	7th grade	Fairly easy to read.
60.0–70.0	8th & 9th grade	Plain English. Easily understood by 13- to 15-year-old students.
50.0–60.0	10th to 12th grade	Fairly difficult to read.
30.0–50.0	college	Difficult to read.
0.0–30.0	college graduate	Very difficult to read. Best understood by university graduates.

The Fry Readability Formula is another common readability test. It requires no computer or special tools. By following the formula directions, users can assess readability by using the Fry Readability Graph (Fry, 1977). You can find detailed instructions for the Fry Formula in Appendix C.



The Checklist Approach

Some argue that readability formulas, such as Flesh and Fry, miss several key factors in their approach (Westphal Irwin & Davis, 1980). The readability checklist approach gathers information that may be missed by readability formulas. You might add or subtract checklist elements based on your subject matter but here is a standard template to work with:

Table 7: Sample Readability Checklist (Conrath Doak, 1996)

<p>Organization</p> <ul style="list-style-type: none"><input type="checkbox"/> Stresses the ‘Need to Know’ information.<input type="checkbox"/> Introduces the most important information early.<input type="checkbox"/> Presents not more than two to three main points.<input type="checkbox"/> Uses headers and summaries to show organization and provide message repetition.<input type="checkbox"/> Paragraphs and sections are short. <p>Writing Style</p> <ul style="list-style-type: none"><input type="checkbox"/> Writing is in active voice.<input type="checkbox"/> Writing addresses one person, not a group.<input type="checkbox"/> Words are common and sentences are short.<input type="checkbox"/> There is little technical jargon and difficult terms are clearly defined.<input type="checkbox"/> The same terms are used consistently for a specific thought or object. <p>Appearance</p> <ul style="list-style-type: none"><input type="checkbox"/> Information is uncluttered, there is ample white space.<input type="checkbox"/> Print size is at least 12-point, serif font.<input type="checkbox"/> Illustrations are simple and add to information objectives. <p>Appeal</p> <ul style="list-style-type: none"><input type="checkbox"/> Materials are culturally appropriate.<input type="checkbox"/> Materials match the language and experience of the target audience.<input type="checkbox"/> Interaction is included via reflective questions, activity suggestions, etc.
--

8b. Seeking Target Audience Input

As mentioned in the planning checklist, testing materials is a critical part of material development. Test early and often, at least twice.

Why Test? (Conrath Doak, 1996):

- Identify information gaps and unclear areas.
- Gather input on content format and design.
- Ensure cultural acceptability.
- Test the clarity of behavioral action.

Table 8: Elements to Test (Conrath Doak, 1996)

Attractiveness	Does the material attract the user? Are the visuals of interest? If in an audio format, is it easy to listen to?
Comprehension	Can the user summarize the main learning objectives and key points of information? Are there areas of confusion?
Self-efficacy	Does the user feel confident in reading or listening to the material? Or do they find areas of it to be inaccessible?
Cultural acceptability	Is the message and format culturally acceptable?
Influence	Does the material influence the user to take action or make a behavior change? Do they think others in their community would do so? If not, what would help make the materials more effective?

Testing Steps

1. Prepare

- a. Determine if you'd like feedback on all of the materials or on specific portions of the materials.
- b. Decide the format of the testing process and the size of the group. You may choose to do a one-on-one interview or a small focus group.
- c. Develop questions for the test that match the elements listed in Table 3. See a list of sample questions in Table 4.
 - i. Use open-ended questions and an unbiased tone.
 - ii. Do not overwhelm the group with questions. Establish fewer, more meaningful questions rather than a lot of empty questions.
- d. Recruit the target audience focus group and coordinate a site and time that works for them. Ask for their input on location and timing rather than assuming you know what works best.

2. Interview

- a. Record the session so you have participant responses to refer back to or recruit a helper to take notes.

3. Evaluate Input and Revise Materials

- a. Study participant responses and highlight key areas of confusion. Consider their suggestions and make edits based on participant input.
- b. After making edits, you may choose to seek additional target audience feedback.



Table 9: Sample Interview Questions (Conrath Doak, 1996 and Federal Plain Language Guidelines, 2011)

- Tell me in your own words, what is this all about?
- What are some words you would use to describe this [factsheet, website, video, etc]?
- What catches your eye?
- What do the pictures tell you?
- Do you think you could do what the picture suggests?
- Are any words difficult for you? Which ones?
- Would you need to know anything else to do [this behavior]?
- Do you think your friends and neighbors would be willing to try this? Could you tell me why?
- Is there anything here that makes you uncomfortable or is not acceptable for you or your community?
- Thinking of other people who might use this, what might work well for them? What might cause them problems?
- Can you think of ways this could be improved?

9. A Case-Study: Adapting GBL resources

For this case study we coordinated four focus groups in key regions of New York State. For each focus group we worked with local CCE Educators to recruit participants who either worked with low-literacy audiences or who were considered to be low-literate. Each focus group was one-hour long and had 4-5 participants. During the one-hour timeframe participants were given 3-4 resources to review and provide feedback. We reviewed one resource at a time, giving participants a few moments to look at the resources independently before having a group discussion. The focus group facilitator took detailed notes while participants circled, underlined, drew or wrote on each resource. All resources were collected at the end of the focus group to be reviewed and interpreted. After the focus group the notes and resources were interpreted and common themes were identified. Each participant received a small stipend for their participation in the focus group. The full focus group outline can be found in the appendix.

Focus group participants were critical in identifying jargon and other commonly unfamiliar words. Participants provided valuable insight on the relevance and appropriateness of

photographs, general formatting and language-use. Several themes surfaced as a result of our four regional focus groups. In Table 10 you can find a summary of the themes.

Table 10: A Summary of Focus Group Findings

- **Know your audience.** When developing a resource, consider the intended audience. For example, skill level, cultural appropriateness, etc. Consider developing different versions of the same resource for different target audiences, e.g., a beginner, intermediate or advanced version; a plain language version and more advanced language version.
- **Be mindful of how the resource begins.** Is the intended audience clearly defined? Are the learning objectives defined?
- **Pictures add value.** The more photographs and images, the better. Place images towards the beginning of the resource. All images should be clearly labeled.
- **Formatting counts.** The more white space on a resource the better, it makes it look more approachable and easy to understand.
- **Bulleted text makes the information easier to follow.** Similarly, checklists work well by adding an element of interaction.
- **Concrete examples are helpful.**
- **Beware of jargon.** Be thorough in defining terms and providing readers with the proper pronunciation.
- **Be mindful of how the resource ends.** Does the viewer know where to go for more information? Are the additional resources appropriate for the intended audience's skill level?

We used four resources as our case study focus materials, each of which went through several revisions in order to improve readability and accessibility. Each resource and its various stages of development can be found in Appendix D.



10. Conclusion

“As I learned more about literacy, I began to wonder how I could identify non-readers. Then I realized that wasn’t really the issue. I had to change how I presented information so that I could be sure of reaching everyone.” (Conrath Doak, 1996).

Similarly, when we began to investigate the challenge of reaching low-literacy audiences, we wondered about methods to connect with the audience in a sensitive manner. However, as we learned more, we realized that this is more about creating materials that are **accessible to everyone**.

After starting this project, we soon realized the complexity of engaging low-literacy audiences and the other audiences that could benefit from thoughtfully designed and accessible materials. There is much to consider such as questioning our own assumptions, considering the target audience’s needs and acknowledging the nuance and sensitivity necessary when connecting with others. During this short-term grant project we were able to start uncovering key ideas but there is much more work to be done in this arena including professional development for educators and advocacy for lower-literate communities. We hope that this resource has been helpful to you as you continue your work of community outreach and designing accessible educational materials.

Now that you’ve read through the guidelines and best practices for engaging low-literacy adults, how will you use what you have learned during the next 90 days? Take a moment to write down one or two SMART goals that will allow you to serve this audience. SMART goals are Specific, Measurable, Achievable, Relevant and Time-bound (“Goal Setting,” n.d.).

11. Glossary of Key Terms

Age of Post-Literacy is a time when literacy is no longer necessary or valued by society

Flesch Reading Ease is a common readability test; a higher score indicates materials that are easier to read.

Flesh-Kincaid Grade Level is a common readability test that shows a score corresponding to a US grade level.

Fry Readability Test is a common readability test that uses the Fry Readability Graph.

Illiteracy means being unable to read or write.

Literacy is an individual's ability to read, write, and speak in English and compute and solve problems at levels of proficiency necessary to function on the job and in society, to achieve one's goals, and to develop one's knowledge and potential.

Low literacy is a *limited* ability to do what is defined above as literacy.

Plain language is writing that is clear, concise, well-organized, and follows other best practices appropriate to the subject or field and intended audience

Prose literacy is the knowledge and skills needed to perform prose tasks, (i.e., to search, comprehend, and use continuous texts).

Readability

Readability measures word difficulty and sentence length. The more multi-syllable words, and the longer the sentences, the greater difficulty

Science literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity

Self-efficacy is an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments.

12. Learn More

About low-literacy

- National Assessment of Adult Literacy, <https://nces.ed.gov/naal/literacytypes.asp>
- State and County Estimates of Low Literacy, <https://nces.ed.gov/naal/estimates/StateEstimates.aspx>

Writing for low-literacy audiences

- *How to write low literacy materials* from Journal of Extension, <https://www.joe.org/joe/2001february/tt2.php>

About Science Literacy

- What is science literacy, <http://www.literacynet.org/science/scientificliteracy.html>
- *Disparities in science literacy* from Science Magazine, <http://science.sciencemag.org/content/360/6391/861>

About Post-Literate Society

- *What is post literate society*, <https://www.youtube.com/watch?v=ffyfHCEtGtA>

Plain Writing

- <https://www.plainlanguage.gov/law/>

Visit the references page for additional resources to explore. If you know of a resource that should be on this list, please email Fiona Doherty at Fcd9@cornell.edu. Thank you!

13. References

1. American Psychological Association (n.d.). *Teaching Tip Sheet: Self-Efficacy*. Retrieved from <https://www.apa.org/pi/aids/resources/education/self-efficacy.aspx>
2. Center for Plain Language (2018). *Federal Report Card*. Retrieved from <https://centerforplainlanguage.org/reports/federal-report-card/>
3. Collins Dictionary Site. (2018). Retrieved November 20, 2018, from <https://www.collinsdictionary.com/us/dictionary/english/postliterate>
4. Conrath Doak, C. (1996). *Teaching Patients with Low-Literacy Skills*. Philadelphia: J.B. Lippincott.
5. Cornell University (n.d.). *Goal setting*. Retrieved from <https://hr.cornell.edu/professional-development/career-management/career-management-resources/goal-setting>
6. Groen, J., & Kawalilak, C. (2014). *Pathways of Adult Learning: Professional and Educational Narratives*, (pg. 137-159). Toronto: Canadian Scholars' Press Inc.
7. *Flesh-Kincaid Readability Tests* (n.d.). Retrieved November 20, 2018 from Wikipedia, the Free Encyclopedia:
https://en.wikipedia.org/wiki/Flesch%E2%80%93Kincaid_readability_tests#cite_note-8
8. Fry, E. (1968). A Readability Formula That Saves Time. *Journal of Reading*, 11(7), 575-578. Retrieved from <https://www.jstor.org/stable/40013635>
9. Fry, E. (1977). Fry's Readability Graph: Clarifications, Validity, and Extension to Level 17. *Journal of Reading*, 21(3), 242-252. Retrieved from <https://www.jstor.org/stable/40018802>
10. Marcus, E. N. (2006). The silent epidemic - The health effects of illiteracy. *New England Journal of Medicine*, 355(4), 339-341. <https://doi.org/10.1056/NEJMp058328>
11. National Center for Education Statistics (2003). *Three Types of Literacy*. Retrieved from <https://nces.ed.gov/naal/literacytypes.asp>
12. National Center for Education Statistics State & County Estimates of Low Literacy (2003). *New York 2003*. Retrieved from <https://nces.ed.gov/naal/estimates/StateEstimates.aspx>
13. National Center for Learning Disabilities (2018). *Visual and Auditory Processing Disorders*. Retrieved from <http://www.ldonline.org/article/6390/>
14. National Science Education Standards (1998). *Principles and Definitions*. Retrieved from <https://www.nap.edu/read/4962/chapter/4>
15. Plain Language Action and Information Network. (2011, May 1). *Federal Plain Language Guidelines*. Retrieved from <https://plainlanguage.gov/guidelines/>
16. *Plain Language: A Promising Strategy for Clearly Communicating Health Information and Improving Health Literacy Site*. (2005, November). Retrieved November 19, 2018, from <https://health.gov/communication/literacy/plainlanguage/PlainLanguage.htm>
17. The National Literacy Act of 1991. Public Law 102-73. Available at <http://www.gpo.gov/fdsys/pkg/STATUTE-105/pdf/STATUTE-105-Pg333.pdf> [PDF - 4.7 MB].
18. The Plain Writing Act, (2010). *What is Plain Language?* Retrieved from <https://www.plainlanguage.gov/about/definitions/>
19. Westphal Irwin, J., & Davis, C.A. (1980). Assessing Readability: The Checklist Approach. *Journal of Reading*, 24(2), 124-130. Retrieved from <https://www.jstor.org/stable/40009291>

Appendices



Appendix A

Sample Planning Checklist

Note: The *italicized verbiage* represents sample responses.

1. Who is your target audience?

The general public, individuals who access the Cornell Garden-Based Learning website.

- What are their ages, genders, cultures?
Unknown.
- What do you know about their literacy levels and readiness to learn?
Unknown. Develop materials that can be used by most by adhering to Plan Language Guidelines.
- How might you include or recruit a few target audience members to your planning process? How could you involve them in the materials design? *Work with county educators to identify target audience members in their local community. Invite those people to a lunch and offer a small monetary incentive of \$20 for an hour of their time. Gather their input regarding material design.*

2. Limit the objective(s) and the message

- What are your minimum educational objectives?
Plan for positive youth development in youth garden programs.
- What topics *must* be included?
Generosity, Power, Belonging and Mastery

3. Writing and production phases

- What format will your materials be presented in? For example, factsheet, web-based resource, audio, video, etc.
Factsheet available on our website.
- How will you include interaction?
Reflective questions
- Are there words or phrases that need explanatory examples?
Positive Youth Development

4. Quality Assurance

- When and how will you test the draft and the final version with members from the target audience?
Invite the same group of target audience members to lunch and offer them another monetary incentive of \$20 for an hour of their time. Gather their input on the materials through a structured focus group interview.

- What tool(s) will you use to test readability level?
Microsoft Word's Readability Test
- How will you document the assessment results?
Record each focus group session to refer to at a later time. Save the readability test results for my records.

Appendix B

Planning Checklist Template

Now it is your turn. Use this template as you develop your own materials.

1. Who is your target audience?

- What are their ages, genders, cultures?
- What do you know about their literacy levels and readiness to learn?
- How might you include or recruit a few target audience members to your planning process? How could you involve them in the materials design?

2. Limit the objective(s) and the message

- What are your minimum educational objectives?
- What topics *must* be included?

3. Writing and production phases

- What format will your materials be presented in? For example, factsheet, web-based resource, audio, video, etc.
- How will you include interaction?
- Are there words or phrases that need explanatory examples? If so, explain them here.

4. Quality Assurance

- When and how will you test the draft and the final version with members from the target audience?
- What tool(s) will you use to test readability level?
- How will you document the assessment results?

Appendix C

Directions for the Fry Reading Formula

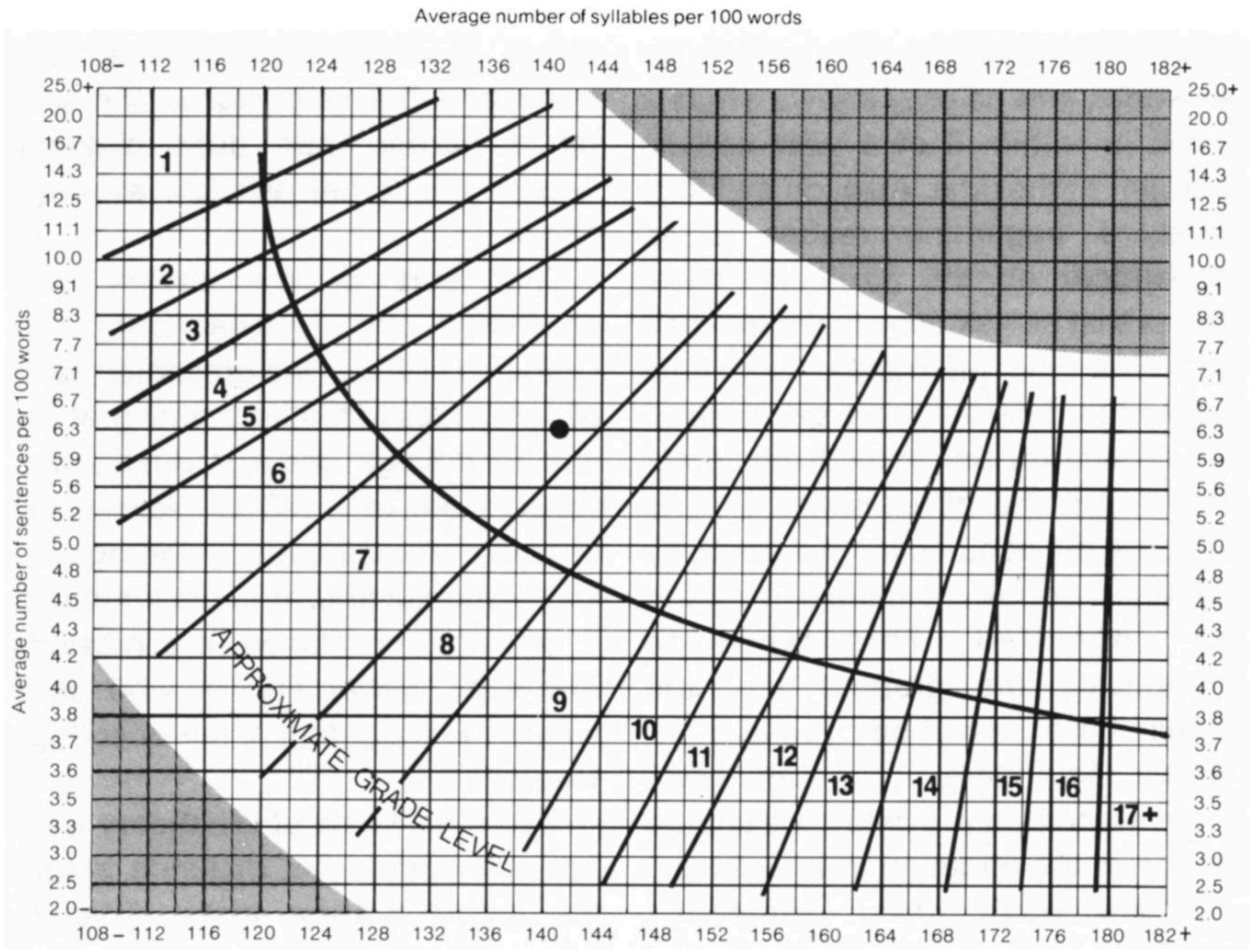
Fry, E. (1977). Fry's Readability Graph: Clarifications, Validity, and Extension to Level 17. *Journal of Reading*, 21(3), 242-252.

1. Randomly select three (3) sample passages and count out exactly 100 words each, beginning with the beginning of a sentence. Do not count proper nouns, initializations and numerals.
 - a. A word is defined as a group of symbols with a space on either side; thus, Joe, IRA, 1945 and & are each one word.
2. Count the number of sentences in the hundred words, estimating length of the fraction of the last sentence to the nearest one-tenth.
3. Count the total number of syllables in the 100-word passage. If you don't have a hand counter available, an easy way is to simply put a mark above every syllable over one in each word, then when you get to the end of the passage, count the number of marks and add 100. Small calculators can also be used as counters by pushing numeral 1, then push the + sign for each word or syllable when counting.
 - a. A syllable is defined as a phonetic syllable. Generally, there are as many syllables as vowel sounds. For example, stopped is one syllable and wanted is two syllables. When counting syllables for numerals and initializations, count one syllable for each symbol. For example, 1945 is four syllables, IRA is three syllables, and & is one syllable.
4. Enter graph with average sentence length and average number of syllables; plot dot where the two lines intersect. Area where dot is plotted will give you the approximate grade level.
5. If a great deal of variability is found in syllable count or sentence count, putting more samples into the average is desirable.

Fry Readability Graph

GRAPH FOR ESTIMATING READABILITY – EXTENDED

by Edward Fry, Rutgers University Reading Center, New Brunswick, N.J. 08904



Appendix D

Focus Group Session Outline Template (1-hour)

Use this outline template as you coordinate your own resource reviewal focus groups.

Preparation:

- Reserve a meeting space and communicate the location with focus group participants. Consider a space that is convenient to your focus group participants, perhaps one that is easily accessible by public transportation. Consider providing childcare, if appropriate. Provide directional signage if needed.
- Print copies of each resource and organize them into folders so that each participant will get a folder that contains each resource. Ensure that the resources are all arranged in the same order within each folder.
- Organize participant stipend payment. If working with cash, place the cash into envelopes for easy distribution. If working with gift cards, have them on hand and ready to distribute.
- If you plan to record the focus group, set up a Zoom meeting or plan another way you wish to record using a phone or camera.

Supplies:

- Copies of each resource for each participant
- Folders for each participant
- Writing utensil for each participant (using a colored pen/pencil such as red could help with the ease of reading participant input)
- Cash or gift cards for each participant
- Nametags + marker
- Laptop (optional for recording)
- Notepad and pen for taking notes
- Directional signage (optional, if needed)

Room set-up: Arrange the space in a welcoming manner. Move tables/chairs into a horse-shoe or clustered shape to encourage discussion.

As participants arrive: If necessary for reporting purposes, ask them for their names. Record the names on a sheet of paper. If they ask, you can let them know that their names will only be used for Cornell’s funding records. If they do not want to provide their name, we can report them as “anonymous.”

- It is important to ask for names and record them yourself rather than having them write down their names. Walking in and being asked to write could create a less-welcoming environment for those with lower-literacy.

Script

5-10 minutes: Welcome and Overview

Welcome! Thank you for taking the time to participate in our focus group today. Your input will be helpful as we strive to develop educational resources that are usable by *everyone*. My name is [Name] and I am a [Tell a little about what you do].

We will be together for about an hour today. During the hour I will share several educational resources that I would like your input on. We will go through each resource one at a time. I will be [recording/taking notes] to capture your thoughts. Feel free to make your own marks directly on the resources. At the end of our time together you will each get a [cash envelope/gift card] as a token of gratitude.

If you need them, the bathrooms are [location]. We will have a brief break but otherwise I will ask you to use the bathroom before or after our session.

[Distribute a folder and writing utensil to each participant]. Please do not skip ahead and look at all of the resources. Open and flip to a resource *only* when you are prompted to do so. We will look at the resources one at a time.

You are welcome to write, underline, circle or draw on the resources. We will also have time for discussion. I will be collecting the resources from you before you leave today.

Do you have any questions before we begin?

10 minutes: Review of Resource 1

Now let's get started. Please open your folders and take out the first resource. Take about 1-minute to look the resource over and make notes. *[Give participants about 1-minute to review the resource in silence. Then, move on to the interview questions to prompt a discussion. See Interview Question Bank on page 3. You may choose to ask each question or bounce around depending on how the discussion flows. Please remember to take extensive notes.]*

10 minutes: Review of Resource 2

Thank you. Let's move on to the second resource. *[Again, give participants about 1-minute to review the resource in silence. Then, move on to the interview questions to prompt a discussion. Do this for each resource].*

5-Minute BREAK *[You may adjust length depending on timing or skip the break altogether.]*

10 minutes: Review of Resource 3

Let's move on to the third resource.

10 minutes: Review of Resource 4

[If time allows, offer the group a fourth resource to review. If you are tight on time, do not offer the fourth resource.]

Let's move on to the final resource.

5-10 minutes: Free Flow Discussion

What other thoughts do you have about educational materials that are accessible to all? What else is important for us to know? Do you have any other comments or questions that we have not yet covered? Any comments or suggestions on the process we used to collect your input today?

5 minutes: Wrap Up

Thank you for your time and attention today! Your input will direct our efforts to simplify educational resources and make them more accessible to all. Please leave the folders and resources on the table and have a safe trip home! [*Distribute a cash envelope or gift card to each participant*].

[*Collect the folders and resources with participant notes. Take a few minutes to capture any last observations or comments that you may have missed during the interview process*].

After focus group: Process the notes you took during the focus group, along with the notes taken by participants. Look for common themes.

Interview Question Bank

- What are some words you would use to describe this resource?
- What catches your eye?
- Are any words hard for you? Which ones?
- Is the print big enough? Too big?
- What do the pictures tell you?
- Would you be willing to try the ideas?
- Do you think your friends and neighbors would be willing to use it? Could you tell me why?
- Is there anything here that makes you uncomfortable or is not acceptable for you or your friends?
- Can you think of ways this resource could be improved?

Appendix E

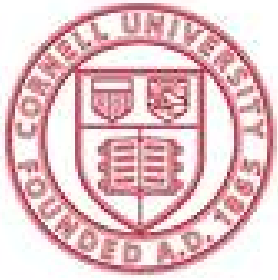
Cornell Garden-Based Learning Case Study Resource Revisions

We took four current garden-based education resources and edited each at least three times in order to improve the readability and accessibility. You'll see many of the themes from the guidelines for best practices reflected in the resource evolution and yet, each resource could continue to be adapted to suit the needs of different viewers.

In the following pages you will find three versions of the following resources:

- Start Plants from Seed
- Plan for Positive Youth Development
- Site Assessment Activity
- Beneficial Insects

The first version of each resource is the original, followed by two edited versions. The final version has the best readability.



Cornell University Cooperative Extension



gardening.cornell.edu

Starting Plants from Seed

Overview

- A terrific activity to do with children and youth!
- Tailored for audiences with special needs.
- Great for both new and experienced gardeners
- The perfect spring activity!

Preparation

Seeds:

Involve youth in the process of deciding what to grow, by providing them with catalogs and asking them to pick two or three varieties of each plant you will grow. Purchase your seeds, or ask a seed company/ store to donate them.

Soil:

Seeds germinate best in a lightweight, fine-textured soil mix that has a high moisture holding capacity. For this particular activity, purchasing good soil will help to ensure the success of the project. Its best to get a commercial "seed-starter" mix – they have a high percentage of vermiculite and/or peat moss.

Containers:

You can use almost any type of container that is clean, has drainage holes, and is no more than two to three inches deep. Many gardeners have extra commercial flats or cell-packs to spare.

Before you get ready to plant, fill clean containers with soil/seed starter mix. Place on a tray of warm water until the soil at the surface is moist. Remove the container from the tray and allow it to drain for several minutes.

Seed Needs

All seeds need a balance of moisture, warmth, light and nutrients! Annuals such as tomatoes are the easiest type to start from seed! Large seeded annuals, such as zinnia and marigold, germinate the most quickly!

Materials

- Seeds, such as tomato, zinnia, marigold, cosmos, cucumber and cabbage
- Note: Start very large
- Trays that can hold water
- Soil and containers
- Light units

Keeping costs down

- Some institutions will float a small loan for supplies.
- You can sell transplants to pay back the loan.
- This also is a great entrepreneurship activity for members of your group to learn communication, provide change, and so forth).

Step by step

1. Pick a method of planting seed.
 - a. Poke holes with the eraser end of a pencil, drop in seeds to the appropriate depth (check the seed packet), then carefully fill over the hole with soil, and tamp gently with the end of the finger to firm soil.
 - b. Fold a file card in half, place several seeds in the crease of the file card, and push seeds off the card into the hole with a toothpick.
 - c. Shake them directly from the seed packet.
 - d. Mix tiny seeds with fine sand or used coffee grounds. The mixture can be put into an empty spice shaker container.
 - e. For limited vision, a magnifying glass can be used.
2. Regardless of your planting method, you should place two - three seeds per container, spacing them evenly, since some will likely fail to germinate.
3. After planting, mist lightly to settle the soil.

Go one step further:

Make home-made seed tape!

1. Cut strips of newspaper about 1 inch wide.
2. Mix a sticky past of flour and water; the consistency of thick gravy seems to work well.
3. Using a Q-tip or artist paint brush as an applicator, dab paste on the newspaper strip, spacing the dabs the right distance apart for the type of seed you're planting.
4. Make correctly spaced red marks on the newspaper ahead of time if participants need help deciding where to apply the glue.
5. Place a seed on each dab and set the strip aside to dry. Large or small seeds lend themselves to this method.
6. Plant the seed tapes (seed side up) and cover as you normally would. Keep them well-watered.

Note: Participants may enjoy the seed starting activity so much, that they may be eager to over-water! Overwatering causes damping off, a fungus which spreads quickly through seedlings, causing them to collapse and die. Avoid this by only watering when the soil begins to dry out at the surface. Watching closely for several days will let you know how often seedlings need a light watering.

Start Plants from Seed

Overview

- A good activity to do with children and youth.
- Great for both new and experienced gardeners.
- The perfect spring activity!



Preparation

Seeds:

Involve youth in the decision-making. Provide them with seed catalogs and ask them to pick two or three varieties of each plant you will grow. Buy your seeds, or ask a seed company or store to donate them. We suggest that very young children start with larger seeds.

Soil:

Seeds germinate best in a lightweight soil mix that can hold moisture. It is best to get a retail "seed-starter" mix that has vermiculite or peat moss.

Containers:

Containers should be clean, have drainage holes and be 2-3 inches deep. You can use any type of container. Many gardeners have extra flats or cell-packs to spare.

Water:

Before you get ready to plant, fill the clean container with soil and place the container on a tray of water until the soil is moist. Remove the container from the tray of water and allow it to drain for several minutes.

Step by step

1. Look at the seed packet for planting information.
 - a. Use a magnifying glass to help with small font.
2. Poke holes in the soil with your finger or the eraser-end of a pencil.
3. Look at the seed packet to find the seed planting depth. Some seeds may not germinate, so you can plant 2-3 seeds per hole. Choose a method to plant the seeds:
 - a. Carefully, place the seeds with your hand.
 - b. Fold an index card in half and place several seeds in the crease of the card. Use a toothpick to push the seeds off of the card and into the hole.
 - c. Shake the seeds directly from the seed packet.
 - d. Mix very small seeds with fine sand or coffee grounds. Put the mixture into an empty spice container and shake the seeds into the hole.
4. Carefully cover the hole with soil.



Seed's Needs

All seeds need a balance of moisture, warmth, light and nutrients. Annuals, such as tomatoes, are the easiest type to start from seed. Large seeded annuals, such as zinnia and marigold, germinate the most quickly.

An **annual** is a plant that completes its life cycle in a single growing season.

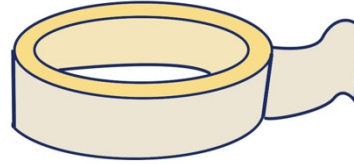
Materials

- Seeds, such as tomato, zinnia, marigold, cosmos, cucumber and cabbage
- Trays that can hold water
- Soil and containers
- Light units (optional)

5. Mist the soil lightly until it is moist. Keep the soil moist but do not overwater. Overwatering causes damping off, a fungus which spreads quickly through seedlings and causes them to die. Only water when the soil begins to dry out at the surface.
6. Keep the tray in a warm place, like on top of a refrigerator. The seeds do not need light until they germinate. When you see growth come through the soil, the seeds have germinated. Once they germinate, place the tray in a bright windowsill or under a light unit.

Go further, make homemade seed tape!

This method works well with large or small seeds.



1. Cut strips of newspaper about 1-inch wide.
2. Mix flour and water into a sticky paste until it is the consistency of thick gravy.
3. Use a Q-tip or small paint brush to put paste on the newspaper strip. Space the paste to match the desired planting distance.
 - a. Make red marks on the newspaper ahead of time if participants need help with correct spacing.
4. Place a seed on each paste mark and set the strip aside to dry.
6. Plant the seed tapes seed side up and cover with soil. Keep the area moist but do not overwater.

Keep costs down

- Ask your local garden stores for seed and soil donations.
- Write to seed companies to request donations of last year's seed.
- Sell the seedlings you've started to offset your supply costs. This can be a great way for members of your group to learn business skills.



References: Capon, B. (2010). *Botany for Gardeners* (Third). Portland, Oregon: Timber Press, Inc.

Adapted by Fiona Doherty, December 2018

Images sourced from <http://clipart-library.com/>

Start Plants from Seed

This resource is for experienced gardeners who work with youth in the garden setting.



Preparation

Seeds:

Involve youth in the decision-making. Provide them with several and ask them to pick two or three varieties of each plant you will grow. Buy your seeds, or ask a seed company or store to donate them. We suggest that very young children start with larger seeds.



Soil Mix:

Seeds grow best in a lightweight soil mix that can hold moisture. It is best to get a retail "seed-starter" mix that has vermiculite or peat moss.



Growing Containers:

Containers should be clean, have holes that allow extra water to drain-out and be 2-3 inches deep. You can use any type of container such as clean egg cartons or yogurt containers. Many gardeners have extra flats or cell-packs to spare.



Water:

Before you get ready to plant, fill the clean container with soil mix and place the container on a tray of water until the soil mix is moist. Remove the container from the tray of water and allow it to drain for several minutes.

Materials

- Seeds
- Annuals such as radish, lettuce, beans, tomato, zinnia, marigold, cosmos, cucumber and cabbage can be easiest to grow

- Trays that can hold water
- Soil mix
- Containers
- Ruler

Optional:

- Grow Lights
- Index card
- Toothpick
- Pencil

An **annual** is a plant that completes its life cycle in a single growing season, it flowers and dies in one year.

Seeds' Needs

All seeds need a balance of moisture, warmth, light and nutrients. Nutrients give plants the important elements that they need to grow.

Step-by-step

1. Look at the seed packet for planting information.



2. Poke holes in the soil with your finger or the eraser-end of a pencil.



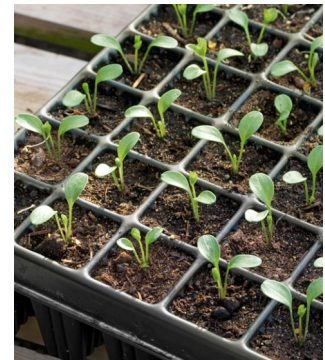
3. Look at the seed packet to find the seed planting depth. Some seeds may not germinate, so you can plant 2-3 seeds per hole. Choose **one** method to plant the seeds:
 - Carefully, place the seeds with your hand.
 - Fold an index card in half and place several seeds in the crease of the card. Use a toothpick to push the seeds off of the card and into the hole.
 - Shake the seeds directly from the seed packet.
 - Mix very small seeds with fine sand or coffee grounds. Put the mixture into an empty spice container and shake the seeds into the hole.

4. Carefully cover the hole with soil mix.

5. Mist the soil lightly until it is moist. Keep the soil moist but do not overwater. Overwatering causes damping off, a fungus which spreads quickly through seedlings and causes them to die. Only water when the soil begins to dry out at the surface.



6. Keep the tray in a warm place, like on top of a refrigerator or on a heat mat. The seeds do not need light until they germinate. When you see growth come through the soil, the seeds have germinated. Once they germinate, place the tray in a bright windowsill or under a light unit.



Go further, make homemade seed tape!

This method works well with large or small seeds.



1. Cut strips of newspaper about 1-inch wide.
2. Mix flour and water into a sticky paste until it is the consistency of thick gravy.
3. Use a Q-tip or small paint brush to put paste on the newspaper strip. Space the paste to match the desired planting distance.
 - a. Make red marks on the newspaper ahead of time if participants need help with correct spacing.
4. Place a seed on each paste mark and set the strip aside to dry.
6. Plant the seed tapes seed side up and cover with soil. Keep the area moist but do not overwater.

Keep costs down

- Ask your local garden stores for seed and soil donations.
- Write to seed companies to request donations of last year's seed.
- Sell the seedlings you've started to offset your supply costs. This can be a great way for members of your group to learn business skills.
- Call your friends, exchange seeds and supplies.
- Look for local seed exchange programs.



References: Capon, B. (2010). *Botany for Gardeners* (Third). Portland, Oregon: Timber Press, Inc.

Adapted by Fiona Doherty, 2019

Images sourced from <http://clipart-library.com/> <https://www.shutterstock.com/search/empty+egg+carton>
<https://www.bootstrapfarmer.com/products/extra-strength-seedling-starter-tray-kits-deep-soil-block-trays>

<http://lakestreetsupply.com/index.php?/products/detail/519/10/291/291>

<https://www.gardeners.com/how-to/how-to-start-seeds/5062.html>

<https://countryandvictoriantimes.com/2012/05/04/save-your-garden-seeds/>

<https://www.hobbyfarms.com/how-to-read-a-seed-packet/>

<https://www.countryliving.com/gardening/garden-ideas/advice/g1418/seed-starting/>

Note:

- This resource has a 5.1 Grade Reading Level

Planning for Positive Youth Development through Garden-Based Learning: Generosity, Belonging, Power, and Mastery

Use this tool to dig deeper into your program activities and support the growth of collaborative, committed, reflective, and caring young people. Consider an activity: planting pumpkins, planning a new garden, or hosting a harvest festival. How might you build in opportunities for generosity, belonging, power, and mastery?

GENEROSITY :: “I can make a difference.”

Strategies:

- Show how garden skills can be used in positive ways.
- Respect and encourage friendships.
- Encourage compassion for others, and concern for the earth.
- Reinforce gestures of caring, and ask young people to take responsibility for helping others.
- Share the harvest—consider all the ways to extend what you are learning and growing to improve the lives of others.
- Establish a mentoring component to link older students with younger students.



POWER :: “I matter.”

Strategies:

- Ask yourself: “Is there something I am doing that a young person could be learning by doing?”
- Include children in discussions and encourage their input.
- Ask children to do something instead of telling them to do it.
- Give children responsibility with a minimum of reminders.
- Commend children who recognize the limits of their independence and seek counsel.
- Allow children the thrill of overcoming an obstacle.
- Maintain a close link between independence and responsibility. Share decision-making with young people by involving them in running the garden program.



BELONGING :: “I belong here.”

Strategies:

- Encourage students work together to complete tasks.
- Spend time gardening with students, and take your time!
- Think of ways to involve families and community.
- Work in small groups to encourage close relationships.
- Promote collaborative and cooperative learning.
- Show respect for the value of diverse cultures.
- Provide multiple opportunities for youth to develop relationships with adults.
- Be sure to have time for fun!



MASTERY :: “I can.”

Strategies:

- Include hands-on activities, projects or exhibits.
- Think of ways to show how gardening relates to workplace-related challenges and activities that apply to daily life.
- Include different ways to investigate and discover.
- Think of multiple outcomes.
- Focus on the long-term goals of learning.
- Provide prompt feedback.
- Model and teach that failure and frustration are learning experiences.



Plan for Positive Youth Development Through Gardening

Use this tool to support the positive development of young people. How can you build generosity, belonging, power, and mastery into garden-based activities?

Generosity: “I can make a difference.”

- Show how garden skills can be used in positive ways.
- Respect and encourage friendships.
- Encourage compassion for others, and concern for the earth.
- Reinforce gestures of caring.
- Share the harvest.
- Set-up mentoring relationships.



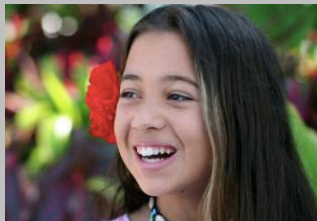
Belonging: “I belong here.”

- Encourage youth to work together.
- Spend time gardening with youth, and take your time!
- Involve families and community.
- Work in small groups to encourage close relationships.
- Promote collaborative learning.
- Show respect for the value of diverse cultures.
- Provide opportunities for youth to develop relationships with adults.
- Save time for fun!



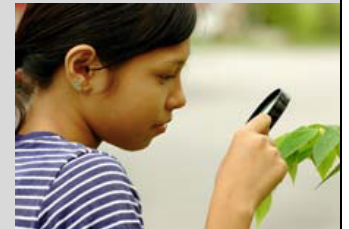
Power: “I matter.”

- Reflect: “Is there something I am doing that a young person could be doing?”
- Share decision-making with young people.
- Include youth in discussions and encourage their input.
- Ask instead of telling youth to do something.
- Praise youth who know their limits and seek help.
- Allow youth the joy of solving a problem.



Mastery: “I can.”

- Include hands-on activities and projects.
- Show how gardening skills apply to daily life.
- Include different ways to be involved with learning.
- Focus on the long-term goals of learning.
- Provide timely feedback.
- Model that mistakes and frustrations are a type of learning.



Build generosity, belonging, power and mastery into garden activities

This resource is for educators who engage youth in the garden setting. By building in each of these four elements, you will create a powerful and positive learning environment.

Generosity: “I can make a difference.”

- Show how garden skills can be used in positive ways.
- Respect and encourage friendships.
- Encourage kindness for others, and concern for the earth.
- Reinforce gestures of caring.
- Share the harvest.
- Set-up mentoring relationships.



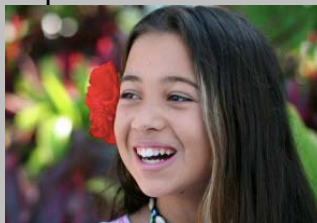
Belonging: “I belong here.”

- Encourage youth to work together.
- Spend time gardening with youth and take your time!
- Involve families and community.
- Work in small groups to encourage close relationships.
- Promote learning together as a group.
- Show respect for the value of all cultures and differences.
- Provide opportunities for youth to develop relationships with adults.
- Include flexible timing for goals.
- Save time for fun!



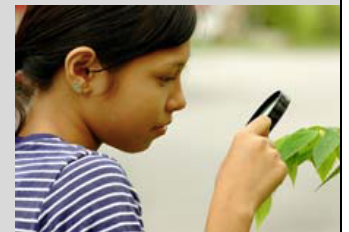
Power: “I matter.”

- Reflect: “Is there something I am doing that a young person could be doing?”
- Share decision-making with young people.
- Include youth in discussions and encourage their input.
- Ask instead of telling youth to do something.
- Praise youth who know their limits and seek help.
- Allow youth the joy of solving a problem.



Mastery: “I can.”

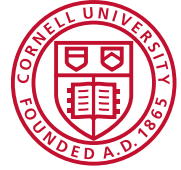
- Include hands-on activities and projects.
- Show how gardening skills apply to daily life.
- Include different ways to be involved in the learning process.
- Focus on the long-term goals of learning.
- Provide timely feedback.
- Model that mistakes and frustrations are a type of learning.



Note: This resource has a 5.9 Grade Reading Level

Cornell Cooperative Extension

Cornell Garden-Based Learning



Site Assessment Activity

Learning Objective:

- Apply basic site assessment criteria to a familiar landscape.

Supplies:

- Paper, pencil and clipboard. Optional: Camera

Activity Time: 1 hour

Directions:

Using your property or another familiar landscape such as a nearby park, walk through the site assessment checklist to learn more about the site. Make notes, draw a basic sketch or take photos to represent each bullet.

Optional: Take the activity a step further and create a base map for the site. See the optional 'Garden and Landscape Area' handout.

Site Assessment Checklist

Name of Property:

USDA Hardiness Zone:

Last Spring Frost:
Last Fall Frost:

Aspect, Include North Arrow

North
South
East
West

Sunlight

Full sun (6 hours or more)
Partial sun
Shade

Slopes

Steep
Moderate
Gradual or flat

Microclimate factors:

Reflected heat
Frost pocket

Soil texture

Clayey
Loamy
Sandy
Silty

Wind:

Windy site
Windy in isolated sections
Calm site

Soil compaction

Compacted
Partially compacted
No compaction

Obstructions

Below ground (e.g. utilities or irrigation system)
Above ground (e.g. overhead wires)

Soil drainage characteristics

Wet
Well-drained
Dry

Wildlife interference

Serious and obvious concerns
Marginal concerns
Not a problem

Building Strong and Vibrant New York Communities

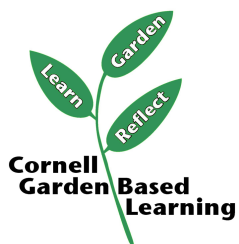
Diversity and Inclusion are a part of Cornell University's heritage. We are a recognized employer and educator valuing AA/EEO, Protected Veterans, and Individuals with Disabilities.

Unusual conditions:

Soil pH:

Existing Plants:

Notes:



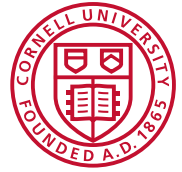
References: *Site Assessment for Better Gardens and Landscapes*, Charles Mazza;
Landscape for Life Student Manual

Published: October 2018

Compiled by: Fiona Doherty

Reviewer: Amy Albam, Jonathan Russell-Anelli, Donna Alese Cooke

Cornell Cooperative Extension Cornell Garden-Based Learning



Site Assessment Basics

Learning Objective:

- Understand a basic site assessment.

Supplies:

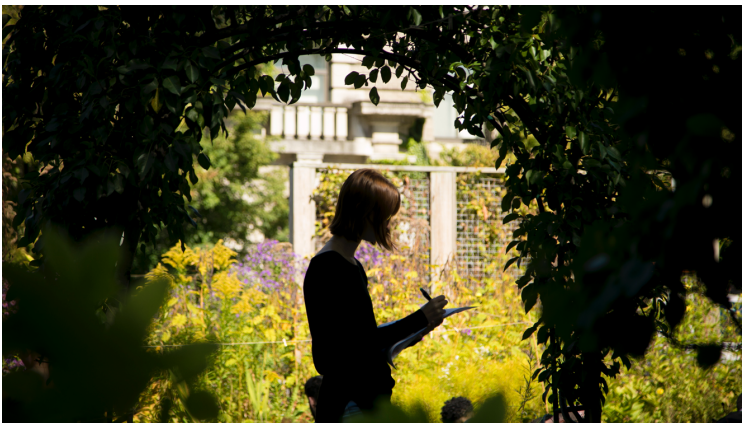
- Paper, pencil and clipboard.
- Optional: Camera

Activity Time: 1 hour

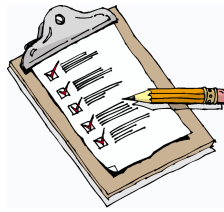
Directions:

- Get to know a garden or landscape by observing the site.
- Explore the site by going through the site assessment checklist.
- Make notes, drawings or take photos for each bullet on the checklist.

Exploring a site helps us determine what plants might do well there.



Site Assessment Checklist



Name or location of property:

What direction is north? How can you tell?



How many hours of sunlight does the site get?

- Full sun (6 or more hours)
- Partial sun
- Shade



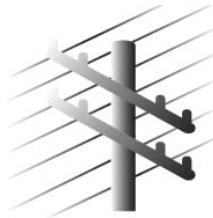
Are there sloped areas?

- Steep
- Moderate
- Gradual or flat

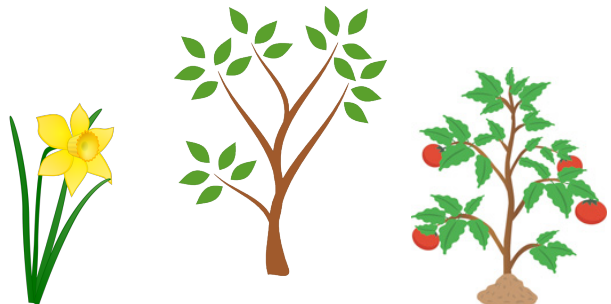


Are there obstructions?

- Above ground?
- Below ground?



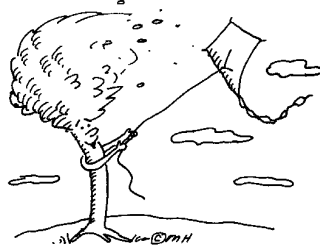
What existing plants do you see?
(Simple description)



- Are there pollinators such as bees or butterflies?



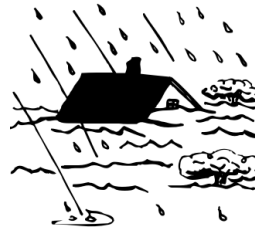
- Is the site windy?



- What does the soil look like?
 - Color:
 - Texture or feel:



- Do you see standing water or puddles?



- Do you see signs of wildlife?
 - Chew-marks on plants
 - Foot prints
 - Animal scat

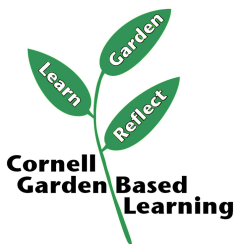
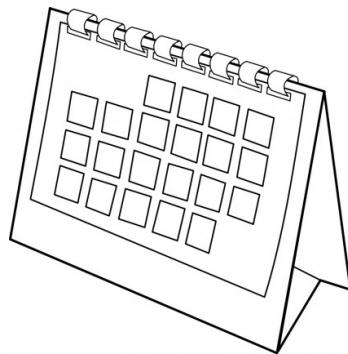


- Is there anything unusual about the site?

What else do you notice?

Going Further:

1. What USDA Hardiness Zone is the area? When is the last Spring Frost and the first Fall Frost? How might this impact the plants you choose?
2. Were you surprised by any of your findings?
3. How will your observations inform your garden project goals?

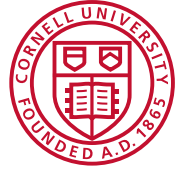


References: *Site Assessment for Better Gardens and Landscapes*, Charles Mazza;
Landscape for Life Student Manual

Images sourced from: <http://clipart-library.com>,
<https://brand.cals.cornell.edu/photography/photography-collection/>
and <https://content.ces.ncsu.edu/extension-gardener-handbook/4-insects>

Compiled by: Fiona Doherty
Reviewer: Marcia Eames-Sheavly

Cornell Cooperative Extension Cornell Garden-Based Learning



Garden Site Assessment Basics

It is important to do a basic site assessment before planting a garden. By exploring a garden site and its characteristics we can determine what plants will grow well there. This checklist will guide you through a basic garden site assessment.

Supplies:

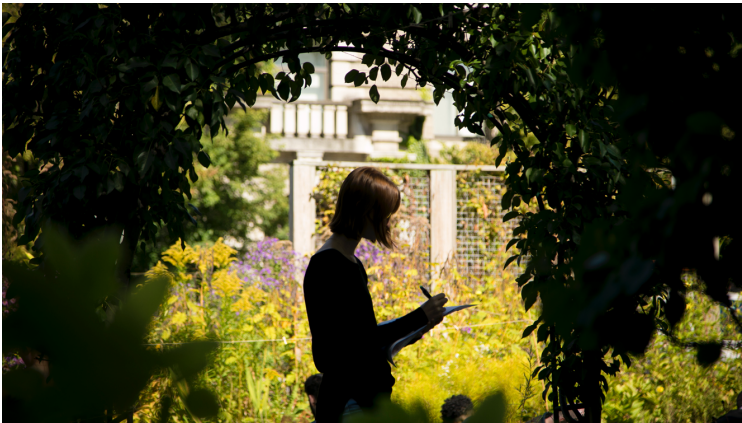
- Paper, pencil and clipboard
- Gloves for handling soil
- Optional: Camera



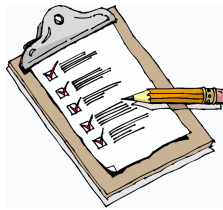
Activity Time: 1-2 hours

Directions:

- Get to know a garden or landscape by observing the site.
- Explore the site by going through the site assessment checklist.
- Make notes, drawings or take photos for each bullet on the checklist.



Site Assessment Checklist



Name or location of property:

What direction is north? How can you tell?



How many hours of sunlight does the site get?

- Full sun (6 or more hours)
- Partial sun
- Shade



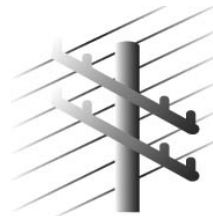
Are there sloped areas?

- Steep
- Moderate
- Gradual or flat

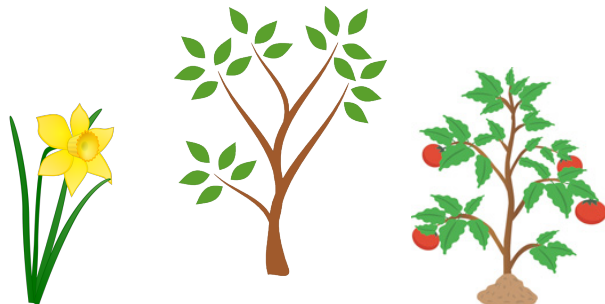


Are there obstructions? (powerlines, fences, etc.)

- Above ground?
- Below ground?



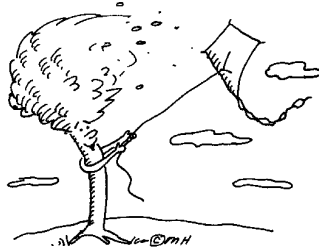
What existing plants do you see?
(Simple description)



- Are there pollinators such as bees or butterflies?



- Is the site windy?



- What does the soil look like?

- Color:
- Texture or feel:



- Do you see standing water or puddles?



- Do you see signs of wildlife?

- Chew-marks on plants
- Foot prints
- Animal scat

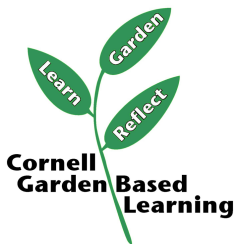
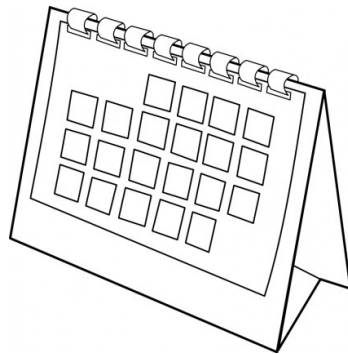


- Is there anything unusual about the site?

What else do you notice?

Next Steps:

- Now that you have gone through the site assessment checklist, take some time to review your notes.
 - What does this information tell you?
 - What plants will do well in this type of environment?
- The USDA Hardiness Zone Map helps gardeners decide what plants will do well in their region. Visit the USDA Hardiness Zone Map, <https://planthardiness.ars.usda.gov/PHZMWeb/>
 - What USDA Hardiness Zone is the area?
 - When is the last Spring Frost and the first Fall Frost?
 - How might this impact the plants you choose?
- Contact the local Cornell Cooperative Extension in your community to talk with a gardening expert. Visit their website to explore their gardening resources. <http://cce.cornell.edu/>
- If you would like to learn more about your garden soil, you can perform a soil test. Work with your local Cornell Cooperative Extension or visit Cornell's Soil Testing Services website to learn more, <https://soilhealth.cals.cornell.edu/testing-services/>



References: *Site Assessment for Better Gardens and Landscapes*, Charles Mazza;
Landscape for Life Student Manual

Images sourced from: <http://clipart-library.com>,

<https://brand.cals.cornell.edu/photography/photography-collection/>

and <https://content.ces.ncsu.edu/extension-gardener-handbook/4-insects>

Compiled by: Fiona Doherty

Reviewer: Marcia Eames-Sheavly

Note:

- Overall, this resource was received the best during the focus groups. It was the only one considered appropriate for low-literacy audiences.
- This resources has a 4.2 Grade Reading Level.



Beneficial Insects - Nature's Pest Control

With the ecological mistakes of humans becoming more apparent, it is reassuring to know that nature can establish certain controls that prevent some destructive insects from overpopulating the environment. We can encourage and prepare the conditions for an increase in insect predator populations. The first step is to be able to identify the beneficial insects.

Some predatory insects such as ladybird beetles and praying mantids are available for sale. Ladybird beetles purchased in the spring have likely been collected during their winter hibernation, and upon release will soon fly away, often far from their release site. Buying predatory insects for releasing in the home garden in order to control insect pests is likely to result in disappointment. It may be more useful to attempt to conserve the natural predators already present in the area.

Lady Beetles (Ladybird Beetles; Ladybugs)

Family: Coccinellidae



Adult.



Larva.

Lady beetles are small, oval, convex and often brightly colored. Most of this family are predaceous both as larvae and adults, and feed chiefly on aphids. They also eat scale insects and mealybugs. Ladybird Beetles are found frequently on vegetation where aphids are numerous. They hibernate as adults, commonly under leaves and debris in large aggregations. One of the native species is the Two-spotted Lady Beetle, which is orange-red, with one black spot on each wing cover.

A species often seen on houses in the autumn and indoors over winter is the Multicolored Asian Lady Beetle, which varies in color and number of spots.

Ground Beetles

Family: Carabidae



The family Carabidae (Ground Beetles) has many hundreds of species that vary in size, shape and color. Most of these insects are somewhat flattened, dark brown or black, and shiny. They may be found under stones, logs, bark, debris or running about on the ground. Most of them hide during the day and feed at night.

Nearly all are predaceous on other insects and many are beneficial by feeding on pest insects. There are also some Ground Beetles that feed on slugs and snails.

Adult.

Praying Mantids

Family: Mantidae



Nymph.



Egg case.

Adults and the immature (nymph) stages of the praying mantis look similar. These are highly predaceous insects that feeds on a variety of other insects. The mantids wait to ambush their prey with the front legs in an upraised position that gives them their name.

Praying mantis egg cases may be found on tree twigs and in fields, and for some fun, you may wish to watch them hatch in your own garden next spring. Eggs cases may be gathered by cutting the twig you find them on, then tying the case to a branch in your garden. The young come tumbling out of their case by the hundreds in the spring. Praying mantids are cannibalistic and will eat one another. Only a few will survive under home garden conditions.

Dragonflies

multiple Families in the Order Odonata



Adult.



Nymph.

Adult dragonflies can be seen actively hunting flying insects, but tend to be more common closer to water. The adults hunt for insect prey using their large eyes and scoop it up with their spiny legs, all while flying. Many small midges, gnats, and mosquitos are eaten, but generally not enough to fully control their populations. Sometimes larger prey are captured, such as butterflies.

The immature dragonfly stages (the nymphs) live underwater, and feed on whatever they can catch, including aquatic insects and sometimes even small fish.

Hover Flies

Family: Syrphidae



Adult.



Larva, with aphids.

Hover Flies are also known as Syrphid Flies or Flower Flies. They may be brightly colored, and many resemble wasps and bees hovering over flowers. However, these flies do not sting. The larvae of most species are predaceous, feeding on aphids or the young of termites, ants, or bees.

Not all Hover Flies are beneficial: the Narcissus Bulb Fly has larvae that damage bulbs of daffodil and related garden flowers.

Lightningbugs; Fireflies

Family: Lampyridae



Adult.



Larva.

The Fireflies or Lightningbugs are neither flies nor bugs, but are beetles. During the early summer the adults fly about in the evenings and are conspicuous by their blinking yellow light. The larvae are beneficial by feeding on various smaller insects, slugs, and snails.

Antlions

Family: Myrmeleonidae



Larva.



Pits made by larvae.



Adult.

Also known as doodlebugs, antlion larvae have long sickle-shaped mouthparts which they use to grab their prey. The larva makes a pit in sandy soil and lies in wait underground at the center. When an ant stumbles in, the ant lion larva flicks sand at it until it slides down the pit into its jaws. Antlions are most common in dry sandy soils.

Lacewings

Families: Chrysopidae and Hemerobiidae



Larva, with aphids.



Adult.

Lacewing adults are about three-quarters of an inch or less in length, with delicate, gauzy, green or brown wings. Some species have jewel-like golden eyes.

The larvae are grayish brown, with sharp curved jaws that extend beyond the head. Larvae crawl along the leaf surface in search of aphids, scales, mealybugs, thrips, mites, and insect eggs. Full-grown larvae can consume 100 or more insects a day.

Parasitoid Wasps

Families: Braconidae, Ichneumonidae, and others



Braconid wasp pupae on a caterpillar.



Ichneumon wasp adult.

There are hundreds of species of parasitoid wasps that can be important in controlling populations of other insects. The most commonly noticed ones are Braconid and Ichneumonid wasps. Many other parasitoid wasp species are much smaller, only a few millimeters long.

The wasps typically have a larval stage that feeds on the inside of the host insect, and the larvae slowly devour the host, which eventually dies. Some of the wasps emerge to pupate on the outside of the host, others develop into pupae inside and emerge from the host as adults.

Prepared 1972 by Carolyn Klass & Prof. Warren T. Johnson, Dept. of Entomology, Cornell University.

Updated 2012 by Jason J. Dombroskie, Ph.D., Dept. of Entomology, Cornell University. All photographs © 2012 by J.J. Dombroskie.

<http://idl.entomology.cornell.edu>

Beneficial Insects: Nature's Pest Control

Beneficial Insects can prevent some insect pests from crowding the environment. We can encourage and prepare the conditions for beneficial insect populations. The first step is to identify the beneficial insects.

Some predatory insects such as ladybird beetles and praying mantids are available for sale. Buying predatory insects to release in the home garden will likely result in disappointment. It is more useful to conserve the natural predators already present in the area.

Lady Beetles (Ladybird Beetles; Ladybugs)

Family: Coccinellidae



Adult.



Larva.

Lady beetles are small, oval, rounded and often brightly colored. Most of this family is predatory as larvae and adults. They eat aphids, scale insects and mealybugs. Ladybird Beetles are found on vegetation where aphids are numerous. They hibernate as adults, commonly in large groups under leaves and debris.

One of the native species is the Two-Spotted Lady Beetle, which is orange-red, with one black spot on each wing cover. A species often seen on houses in the autumn and indoors over winter is the Multicolored Asian Lady Beetle, which varies in color and number of spots.

Ladybird beetles purchased in the spring have likely been collected during their winter hibernation, and upon release will fly away, often far from their release site.

Ground Beetles

Family: Carabidae



Adult.

The family Carabidae (Ground Beetles) has many hundreds of species that vary in size, shape and color. Most of these insects are somewhat flattened, dark brown or black, and shiny. They may be found under stones, logs, bark, debris or running on the ground. Most of them hide during the day and feed at night. Nearly all of them eat other insects and many are beneficial by feeding on pest insects. There are some Ground Beetles that feed on slugs and snails.

Praying Mantids

Family: Mantidae



Adult.



Egg case.

Adults and the immature (nymph) stages of the praying mantis look similar. These are highly predatory insects that feed on a variety of other insects. The mantids wait to ambush their prey with the front legs in an upraised position that gives them their name. Praying mantis egg cases may be found on tree twigs and in fields. Egg cases may be gathered by cutting the twig you find them on, then tying the case to a branch in your garden. The young come tumbling out of their case by the hundreds in the spring. Praying mantids are cannibalistic and will eat one another. Only a few will survive under home garden conditions.

Dragonflies

multiple Families in the Order Odonata



Adult.



Nymph.

Adult dragonflies can be seen actively hunting flying insects, but tend to be more common near water. The adults hunt for insect prey using their large eyes and scoop it up with their spiny legs, all while flying. They eat many small midges, gnats, and mosquitos, but generally not enough to fully control the populations. Sometimes larger prey are captured, such as butterflies. The immature dragonfly stages (the nymphs) live underwater, and feed on whatever they can catch, including aquatic insects and sometimes even small fish.

Hover Flies

Family: Syrphidae



Adult.



Larva with aphids.

Hover Flies are also known as Syrphid Flies or Flower Flies. They may be brightly colored, and many resemble wasps and bees hovering over flowers. However, these flies do not sting. The larvae of most species are predatory. They feed on aphids or the young of termites, ants, or bees. Not all Hover Flies are beneficial: the Narcissus Bulb Fly has larvae that damage bulbs of daffodil and related garden flowers.

Lightningbugs; Fireflies

Family: Lampyridae



Adult.



Larva.

The Fireflies or Lightningbugs are neither flies nor bugs, but are beetles. During the early summer the adults fly around in the evenings and are identified by their blinking yellow light. The larvae feed on various smaller insects, slugs, and snails.

Antlions

Family: Myrmeleonidae



Larva.



Pits made by larvae.



Adult.

Also known as doodlebugs, antlion larvae have long sickle-shaped mouthparts which they use to grab their prey. The larva makes a pit in sandy soil and waits underground at the center. When an ant stumbles in, the ant lion larva flicks sand at it until it slides down the pit into its jaws. Antlions are most common in dry sandy soils.

Lacewings

Families: Chrysopidae and Hemerobiidae



Larva with aphids.



Adult.

Lacewing adults are about $3 \frac{1}{4}$ of an inch or less in length. They have delicate, gauzy, green or brown wings. Some species have jewel-like golden eyes. The larvae are grayish brown, with sharp curved jaws that extend beyond the head. Larvae crawl along the leaf surface in search of aphids, scales, mealybugs, thrips, mites, and insect eggs. Full-grown larvae can consume over 100 insects a day.

Parasitoid Wasps

Families: Braconidae, Ichneumonidae, and others



Braconid wasp pupae on a caterpillar.



Ichneumon wasp adult.

There are hundreds of species of parasitoid wasps that can be important in controlling populations of other insects. The most commonly noticed ones are Braconid and Ichneumonid wasps. Many other parasitoid wasp species are much smaller, only a few millimeters long.

The wasps typically have a larval stage that feeds on the inside of the host insect, and the larvae slowly eat the host, killing it. Some of the wasps emerge to pupate on the outside of the host, others develop into pupae inside and emerge from the host as adults.

*Prepared 1972 by Carolyn Klass & Prof. Warren T. Johnson, Dept. of Entomology, Cornell University.
Updated 2012 by Jason J. Dombroskie, Ph.D., Dept. of Entomology, Cornell University. All
photographs© 2012 by J.J. Dombroskie.
<http://idl.entomology.cornell.edu>*

Beneficial Insects: Nature's Pest Control

Beneficial insects are good insects that can prevent some insect pests, or bad insects, from harming plants. We can encourage and prepare the conditions for beneficial insect populations. The first step is to identify the beneficial insects.

Lady Beetles (Ladybird Beetles or Ladybugs) **Family: Coccinellidae**



Adult.



Larva.

What it looks like: Lady beetles are small, oval, rounded and often brightly colored.

Where it lives: Lady beetles are found on plants that have a lot of aphids. They hibernate as adults, commonly in large groups under leaves and debris. To hibernate means to spend the winter in a dormant state.

Why it is beneficial: Most of this family is predatory as larvae and adults. They eat aphids, scale insects and mealybugs.

Fun fact: A native species is a species that normally lives in a specific habitat or region. One of the native species of Lady beetles is the Two-Spotted Lady Beetle, which is orange-red, with one black spot on each wing cover. A species often seen on houses in the autumn and indoors over winter is the Multicolored Asian Lady Beetle, which varies in color and number of spots.

Ground Beetles

Family: Carabidae



Adult.



Larva.

What it looks like: The family Carabidae (Ground Beetles) has many hundreds of species that vary in size, shape and color. Most of these insects are somewhat flattened, dark brown or black, and shiny.

Where it lives: Ground Beetles may be found under stones, logs, bark, debris or running on the ground. Most of them hide during the day and feed at night.

Why it is beneficial: Nearly all Ground Beetles eat other insects and many are beneficial by feeding on pest insects. There are some that feed on slugs and snails.

Lightning bugs; Fireflies

Family: Lampyridae



Adult.



Larva.

What it looks like: During the early summer the adults fly around in the evenings and are identified by their blinking light.

Why it is beneficial: The larvae feed on various smaller insects, slugs, and snails.

Fun Fact: The Fireflies or Lightning bugs are neither flies nor bugs, but are beetles.

Praying Mantids

Family: Mantidae



Adult.



Egg case.

What it looks like: Adults and the immature, not fully developed, stages of the praying mantis look similar. The mantids wait to ambush their prey with the front legs in an upraised position that gives them their name.

Why it is beneficial: These are highly predatory insects that feeds on a variety of other insects. Praying mantids are cannibalistic and will eat one another. Only a few will survive under home garden conditions.

Fun Fact: Praying mantis egg cases may be found on tree twigs and in fields. Egg cases may be gathered by cutting the twig you find them on, then tying the case to a branch in your garden. The young come tumbling out of their case by the hundreds in the spring.

Lacewings

Families: Chrysopidae and Hemerobiidae



Adult.



Larva with aphids.

What it looks like: Lacewing adults are about 3 ¼ of an inch or less in length. They have delicate, gauzy, green or brown wings. Some species have jewel-like golden eyes. The larvae are grayish brown, with sharp curved jaws that extend beyond the head.

Why it is beneficial: Larvae crawl along the leaf surface in search of aphids, scales, mealybugs, thrips, mites, and insect eggs. Full-grown larvae can consume over 100 insects a day.

Dragonflies

Multiple Families in the Order Odonata



Adult.



Immature or Nymph.

What it looks like: The adults hunt for insect prey using their large eyes and scoop it up with their spiny legs, all while flying.

Where it lives: Adult dragonflies can be seen actively hunting flying insects, but tend to be more common near water. The immature dragonfly stages (nymphs) live underwater, and feed on whatever they can catch, including aquatic insects and sometimes even small fish.

Why it is beneficial: They eat many small midges, gnats, and mosquitos, but generally not enough to fully control the populations.

Fun Fact: Sometimes larger prey are captured, such as butterflies.

Hover Flies (Syrphid Flies or Flower Flies)

Family: Syrphidae



Adult.



Larva (right) with aphids (left).

What it looks like: Hover Flies may be brightly colored, and may look like wasps and bees hovering over flowers. However, these flies do not sting.

Why it is beneficial: The larvae of most species are predatory. They feed on aphids or the young of termites, ants, or bees.

Fun Fact: Not all Hover Flies are beneficial. The Narcissus Bulb Fly has larvae that damage bulbs of daffodil and related garden flowers.

Antlions (Doodlebugs)

Family: Myrmeleonidae



Adult.



Larva.



Pits made by larvae.

What it looks like: Antlion larvae have long sickle-shaped mouthparts which they use to grab their prey.

Where it lives: Antlions are most common in dry sandy soils.

Why it is beneficial: The larva makes a pit in sandy soil and waits underground at the center. When an ant stumbles in, the ant lion larva flicks sand at it until it slides down the pit into its jaws.

Parasitoid Wasps

Families: Braconidae, Ichneumonidae, and others



Ichneumon wasp adult.



Braconid wasp pupae on a caterpillar.

Why it is beneficial: Parasitoid wasps typically have a larval stage that feeds on the inside of the host insect, and the larvae slowly eat the host, killing it. Some of the wasps emerge to develop into pupae in the outside of the host, others develop into pupae inside and emerge from the host as adults. A pupa is the stage of development between immature and adult insects.

Fun Fact: There are hundreds of species of parasitoid wasps that can be important in controlling populations of other insects. The most commonly noticed ones are Braconid and Ichneumonid wasps. Many other parasitoid wasp species are much smaller, only a few millimeters long.

About purchasing beneficial insects...

Predatory insects, such as ladybird beetles and praying mantids are available for sale. Buying predatory insects to release in the home garden will likely result in disappointment because most will fly away. It is more useful to conserve the natural predators already present in the area.

Lady beetles purchased in the spring have likely been collected during their winter hibernation, and upon release will fly away, often far from their release site.

*Prepared 1972 by Carolyn Klass & Prof. Warren T. Johnson, Dept. of Entomology, Cornell University.
Updated 2012 by Jason J. Dombroskie, Ph.D., Dept. of Entomology, Cornell University. All
photographs© 2012 by J.J. Dombroskie. <http://idl.entomology.cornell.edu>*

Revised 2019 by Fiona Doherty, Cornell Garden-Based Learning.

Ground beetle larva photo sourced from,

<http://www.uky.edu/Ag/CritterFiles/casefile/insects/beetles/ground/ground.htm#cycle>

Note:

There are still several steps that we could take to make this resource accessible to low-literacy viewers.

- Add more photographs of people interacting with insects.
- Replace each insect photograph with one that shows the size and scale of the insect. For example, the insect next to a coin.
- As it is, this resource has a 7.1 Reading Grade Level.