Virginia Master Naturalist Program Basic Training - Citizen Science Presentation Script

Slide 1 Welcome to the Citizen Science and Research Skills presentation for the Virginia Master Naturalist Basic Training Course! Citizen science is one of several major areas of volunteering for Virginia Master Naturalist volunteers.

Slide 2 Before we talk about citizen science, we need to talk about what science itself is and is not. Science is not a collection of facts, but rather a logical process used to answer questions about the natural world. While the process can be different in different situations, scientific inquiry generally follows a logical order of steps that make it possible to draw conclusions based on evidence. People are often most familiar with manipulative experiments, but science can take many other forms, including observational studies and modeling. And, because science is a process, it is something that can sometimes be practiced by people who are not paid professionals.

Slide 3 The scientific process begins with making observations, wondering about patterns or phenomena that you observe, and asking specific questions that can be investigated. Scientists develop hypotheses, or possible explanations for the patterns they observe. They gather evidence, or collect data, and analyze those data to determine which of the possible explanations the data support. They draw conclusions based on those findings, and, as an important part of the scientific process, they share their findings with others, so that others may build upon the results, make more observations, and ask new questions.

Slide 4 We often use the scientific process without thinking about it in our daily lives. Let's imagine you open your refrigerator and smell a bad smell. You've made an observation. Your next step likely is to ask, "What's causing that terrible smell?" You develop hypotheses: "It could be the leftover Chinese food, or it could be the carton of milk." Next you focus on gathering data. You take out the Chinese food. It's only dated yesterday, it doesn't look moldy, and when you smell it up close, it just smells like sweet-and-sour chicken. Next, you check the milk. The expiration date was a week ago, there appears to be some mold growing in it, and when you take a whiff, it smells terrible! You can interpret these data in your head and conclude that the milk was the culprit. If you pour out the milk, and the refrigerator starts smelling better, that's even further evidence. If you are a helpful family member, you'll share your findings, and let others in the household know that you need more milk!

Slide 5 So, what is citizen science? It's science that involves people who may not be professional scientists in the scientific process. Citizen science is a powerful tool for scientific research, education, and community development. (Note to presenters: This could be a good place to watch one or more of videos listed under "Introductory Videos" at http://www.virginiamasternaturalist.org/citizen-science.html.)

Slide 6 Commonly, citizen science projects are contributory, with volunteers involved mainly in the data collection step of the scientific process. However, there are projects that involve a greater degree of collaboration between professional scientists and citizen scientists. There are even co-created projects, in which community members lead all steps of the process in order to address an issue or question of concern. You can read more about these different models of citizen science in a 2012 paper by Shirk et al. in the journal Ecology and Society. (Full citation: Shirk, J. L., H. L. Ballard, C. C. Wilderman, T. Phillips, A. Wiggins, R. Jordan, E. McCallie, M. Minarchek, B. V. Lewenstein, M. E. Krasny, and R. Bonney. 2012. Public participation in scientific research: a framework for deliberate design. Ecology and Society 17(2): 29. http://dx.doi.org/10.5751/ES-04705-170229)

Slide 7 Citizen science has a long history. Some of the earliest examples of large-scale citizen science projects date back to the 1800s. In fact, there are several citizen science monitoring projects, like the National Audubon Society's Christmas Bird Count, that have been running for well over 100 years.

Slide 8 You can still join others in your community for a Christmas Bird Count today and contribute to this very long-term data set on bird populations.

Slide 9 Although he was not a professional scientist, Thomas Jefferson was known for making and recording meticulous observations about the natural world, and especially the weather. In fact, he started the first network of volunteer weather observers, which started with just a small number of volunteers in the 1800s and now includes thousands of citizen science volunteers in the National Weather Service's Cooperative Observer Program.

Slide 10 In recent years, as technology for data collection and communication over large geographic areas have improved, there has been an explosion of citizen science projects. Some have been started by professional scientists, some by amateur researchers, and some by local groups looking to solve a problem in their communities. Although not all citizen science projects are focused on natural resources, many are, and interested volunteers can contribute to studies on everything from ants to zooplankton!

Slide 11 Now we are going to talk about kinds of citizen science projects Virginia Master Naturalists might do. These projects typically fall into one of three categories: inventory, monitoring, and experimental studies. We'll talk about each of these forms of scientific studies and provide examples of projects that Virginia Master Naturalists are doing. Please see the accompanying handouts for listings of these example projects and many others.

Slide 12 An inventory is making a list or map to document the current status of a resource, the same way you might conduct an inventory of office supplies or food in your pantry. In citizen science, an inventory is usually aiming to document the presence, distribution, and status of plants, animals, water, soil, and other natural resources. Inventories are useful because they can give you baseline data about what is in an area in order to inform decision-making about land management.

Slide 13 Inventories often take two forms – long-term and short-term. These Virginia Master Naturalists helped conduct a plant inventory in a local natural area. To get a complete picture of the status of plant diversity in the area, they conducted surveys for an entire year, so that they could find and identify plants that may only be observed in one season.

Slide 14 Sometimes a short-term inventory can also be appropriate. Short-term inventories are frequently called BioBlitzes, and they may take place in just a 24 or 48 hour period. They are often big educational events, with members of the public working together with experienced naturalists and scientists to find and identify all the species they can in one or more taxa. For example, the Virginia Herpetological Society conducts "Herp Blitzes"—short events where they are trying to document all the diversity of reptiles and amphibians in an area.

Slide 15 These are data from a BioBlitz in Rock Creek Park, in Washington, D.C.. In just one weekend, these volunteers and scientists found well over 600 species in what is a very urban park. This shows you how much is out there to be discovered and documented in our parks and natural areas!

Slide 16 Data from both long-term inventories and BioBlitzes can be useful for making natural resource decisions. For example, if you are planning a new park, you might use information about species diversity and distributions to decide where to put the hiking trails. These data can also be used to better understand the value of a piece of land in terms of its biodiversity, and to get members of the public excited about an area. Sometimes a BioBlitz can uncover a new discovery that leads to action. For example, a 2016 BioBlitz in Hungry Mother State Park in Marion, Virginia found a fish that is not native to the streams there and that could outcompete some of the native fish species that are the focus of conservation efforts. Because of this finding, natural resource managers could take action to remove the fish from this area.

Slide 17 Documenting invasions of non-native species is another type of inventory Virginia Master Naturalists can do. The Mid-Atlantic Early Detection Network is one place to report data. Invasive species documentation is most meaningful when people report areas where they do not see invasives as well as the areas where they do.

Slide 18 WildlifeMapping is an easy project for getting started with citizen science. It's coordinated by the Virginia Department of Game and Inland Fisheries, and it uses an online social media site called iNaturalist to collect and document observations. Interested volunteers simply upload images of animals that they see, and add some additional basic information about location and habitat. You can provide your own identification, but other site users will also provide and confirm identifications. Both this project and the Mid-Atlantic Early Detection Network mentioned on the last slide are not usually thorough inventories of a specific area, but rather a collection of haphazard observations aimed at gaining an understanding of species locations within the entire state or region. Still, these tools could be used for more organized inventories of local areas as well.

Slide 19 Inventories can cover multiple taxa (or types of species), or they can focus on one taxon. The Virginia Breeding Bird Atlas is an example of a long-term, taxon-specific inventory. Volunteers will spend five years surveying all areas of Virginia to document the presence of breeding bird species. The second Virginia Breeding Bird Atlas ever conducted started in 2016. Because a similar Breeding Bird Atlas was completed in the 1980s, we can look at changes in the data to learn about trends in breeding bird populations. When observations are made repeatedly over time, we can go beyond just an inventory of what species are there to monitoring how those natural resources may be changing.

Slide 20 Which brings us to our next form of citizen science. Monitoring involves making the same measurements repeatedly over time. Monitoring is important for documenting and responding to changes in a resource. Monitoring can help you know whether natural resource management is effective. For example, monitoring water quality in a stream before and after installing a riparian buffer can show you whether the buffer has been effective at improving the stream conditions.

Slide 21 Water quality monitoring in local streams, rivers, and lakes is in fact one of the oldest and most popular forms of citizen science. It's also incredibly important here in Virginia. Citizen water quality monitoring efforts have found pollution sources like broken sewer lines that might have remained undetected for a long time without citizen scientist involvement. Because volunteers were collecting data at the same sites repeatedly over time, they quickly saw when conditions changed. You can look for a local stream monitoring group by you on the website of the Department of Environmental Quality.

Slide 22 Virginia Master Naturalists have also worked with partners such as Virginia Commonwealth University's Rice Rivers Center and the Virginia Department of Game and Inland Fisheries to form the Vernal Pool Cooperative of Virginia project, in which volunteers make repeated visits to isolated wetland habitats (called "vernal pools") to record pool conditions and the status of obligatory amphibian species, such as spotted salamanders and wood frogs. These data are helping land managers better protect these special habitats.

Slide 23 The Virginia Working Landscapes project is another example of a citizen science monitoring project. Volunteers assist with annual plant, bird, and pollinator surveys across Virginia's Piedmont. This monitoring is examining species diversity under different grassland management scenarios.

Slide 24 As we try to understand and predict the effects of a changing climate on the natural world, monitoring phenology is particularly important. Phenology is the study of biological responses to seasonal change, such as when trees leaf out, when birds migrate, and when flowers bloom. Projects such as "Nature's Notebook" with the National Phenology Network engage volunteers in recording specific phenological events. When combined together across large landscapes and over many years, these data become powerful indicators of the effects of climate change.

Slide 25 The 4th of July Butterfly Count with the North American Butterfly Association is an annual monitoring effort to document butterfly diversity and abundance. Volunteers count in the same places using the same techniques each year, so that changes over time may be documented. The Monarch Larva Monitoring Project is a species-specific monitoring effort that focuses on studying monarch populations during the breeding season. If you plant a butterfly habitat in hopes of attracting monarchs, following the Monarch Larva Monitoring Project protocols for monitoring can help you track and evaluate whether monarchs are using the site.

Slide 26 Inventories and monitoring are typically observational studies. Experimental studies typically involve manipulation by the researcher. There are not many examples of natural resource citizen science projects that are experimental, but there are a few. In experimental studies, the researcher tests hypotheses by methodically changing one or more conditions and comparing the outcomes to a control group, where the conditions were kept the same. Experimental studies are important for understanding not just how something is changing, but why it is changing. This type of research can be manipulative, where the researcher applies the treatment, or it can be "natural", where the researcher collects data in situations with natural variation in a condition.

Slide 27 In one example, Virginia Master Naturalists in the Historic Southside Chapter conducted a multi-year experiment to identify the best methods for controlling Japanese stilt grass. In far Southeast Virginia, there is a rare, fire-dependent pine savannah habitat that is home to a population of the endangered Red-cockaded woodpecker. A recent incursion of the invasive Japanese stilt grass is of concern because it may alter the fire dynamics at the site, resulting in damage to native shrubs and trees.

Slide 28 The volunteers mapped the invasions of Japanese stilt grass throughout the natural area. This inventory helped them identify the best sites for their experiment.

Slide 29 They then set up experimental plots where they applied different combinations of treatments such as burning and herbicides and varied timing of the treatments.

Slide 30 They measured the effects multiple times throughout the year, and conducted the experiment for multiple years. When the study ends, they will be able to determine which timings and treatments are effective for Japanese stilt grass control in this habitat and make a recommendation to the land manager for how to deal with this invasive plant. This project is also an example of a co-created citizen science project like we mentioned earlier, in which the Virginia Master Naturalist volunteers led every step of the scientific process. Virginia Master Naturalist chapters and volunteers are encouraged to partner with local scientists and land managers to design inventory, monitoring, or experimental studies that address local concerns and questions.

Slide 31 CitSci.org is a website and online tool where you can create a citizen science project and have a portal for planning a project, managing participants, entering data, and analyzing data. The site allows you to customize a project by creating your own data entry forms and approving members who can contribute data to the project. Virginia Master Naturalists use CitSci.org for the Vernal Pool Cooperative study and several other projects.

Slide 32 Any citizen science project is going to require specific skills, such as bird identification or conducting chemical tests for water quality monitoring. But, there are some skills that cross over many projects, and these are skills we hope you will build as a Virginia Master Naturalist volunteer. We'll talk about the first one, recording observations, in detail in this presentation. Using keys and field guides to describe and identify what you see is another important skill. We recommend the hands-on activity that accompanies this curriculum for learning how to use species identification keys. Other important skills include identifying and describing your location, following standardized protocols, and using common sampling techniques and tools. You will likely practice these at various times during your Virginia Master Naturalist basic training course, or in trainings to prepare you for specific projects. Lastly, the ability to recognize typical patterns in nature and to notice anomalies is a skill that simply develops over time as you visit the same places repeatedly and document your observations.

Slide 33 Let's talk now about one of these basic skills. Recording observations in a field notebook is one of the most basic and transferrable skills of a citizen scientist or a naturalist.

Slide 34 Why keep a field notebook? It serves as your memory of natural history observations. Keeping field notes can also improve your observational skills. If you set out on a hike determined to record wildflowers in bloom, you likely will notice more wildflowers. Keeping field notes also is a good way to record any unusual sightings or rare species. You might observe a plant never before recorded in your county, for example, and having the detailed notes about when and where it was observed will be important if your observation is to be used to update information on that plant's distribution. Your field notes can also be useful as long term data. Scientists are using field notes from Thomas Jefferson and Henry David Thoreau to study changes in phenology due to climate change. Having field notes also can be very useful if you plan to do educational programs in an area, or develop educational materials. For example, if you are leading a nature walk in April, you can look back at your field notes from last April and get an idea of what plants you may see in bloom, what birds you may hear singing, or other natural history events. Lastly, documenting your nature observations can help you generate questions and ideas that you can explore through further study or even by developing your own citizen science project.

Slide 35 A field notebook is the place to record your immediate impressions. It should be easy to carry, ready to fit in a pocket or a field backpack. It should be written in pencil so that your observations won't be washed away if it gets wet. You may even want a field notebook that is made from waterproof paper. The exact size, spiral-bound or not, lined or unlined paper, and material are all matters of personal preference. Choose something that you'll enjoy carrying and writing in.

Slide 36 The field notes you take may take many forms. Your field notebook may be very utilitarian, with mostly lists of species observed. Or, it might be very artistic, with sketches of what you see and descriptions of your thoughts and experiences. Or, it could be anywhere in between. It may include accompanying collections and photographs, though if you are collecting, be sure you have all necessary permits and permissions.

Slide 37 Regardless of the style of notes you take, there are some essential entries to include every time so that your observations are well-documented and scientifically useful. Let's talk about each of them. First, you should always record the date and time. If you are in the field for a very long period of time, you may want to add additional updates on the time of day as you go along. You should also include the location. Ideally, your notes on the location include a general site (such as the name of the park and the county, shown here), and a specific location. The specific location may include precise latitude and longitude or GPS coordinates, but it should also always include the distance and direction from a fixed landmark. A fixed landmark would be something like a trail intersection or road crossing. Here, it indicates that the observer was within a tenth of a mile east of the parking lot on the Meadow Loops Trail. Next, record the current weather, such as the air temperature, cloud cover, wind speed, and any precipitation. It's also a good idea to record any significant recent weather of note. It may be warm and sunny today, but perhaps the fact that a hurricane blew through yesterday explains why you've observed this unusual bird today. You'll also want to record the names of your companions or trip leaders. Most of your field notes will likely be of species observations. In some cases, you may just make lists. In other cases, you may want to include identification clues, notes on animal behavior or plant growth patterns. It's also helpful to record habitat characteristics, such as habitat type, forest type, dominant plant species, and amount of

Slide 38 Professional scientists and naturalists frequently transcribe their field notes into a field journal. The field journal is based on the notes in your field notebook, but it is a more permanent record of your observations. In a field journal, you record your observations of the day in complete sentences and in a more permanent fashion. Traditionally, field journals were written in ink in a composition-style book at the end of each field day. Nowadays, many naturalists still do that, but you also might choose to make your field journal a blog, a digital archive, or even a photo slide show with accompanying captions and notes. Regardless of your choice of technology, it is helpful to sift through the field notes that you jotted down in the moment and to compile them in a way that makes them easy to understand and refer back to in the future.

Slide 39 Treat your field notebook and any associated digital files like your keys or wallet…something you are careful not to lose! After all, no one will ever be able to make those observations at that same time and place ever again. Your notes are a unique record.

Slide 40 Starting to keep a field notebook can be daunting! Consider picking a focus. It could be to record observations at just one location you visit regularly. Or, it could be to record observations of just one group of organisms, such as wildflowers in bloom. Or, it could be to record phenology, recording just the first time you see a seasonal phenomenon (like a dogwood in bloom) but not every time. Finding a focus can help you get started with your field notes.

Slide 41 Most citizen science projects will have a data sheet or form for you to complete. It may be a paper copy that you fill out in the field, and then enter online later. It may also be an online form that you complete in the field using a mobile device. Either way, many of the same principles of keeping a field notebook apply. Note that the essential field notebook entries are included on this data sheet.

Slide 42 Being able to document your location is an important part of most citizen science projects that Virginia Master Naturalists might do. You might use a paper map, an online tool like Google Maps, a GPS unit, or a smart phone to identify the latitude and longitude where you made your observations. This can be a pretty critical piece of data, so be sure you have the tools and skills to mark your location before embarking on a citizen science project that requires it.

Slide 43 To wrap up, let's discuss some basic elements of scientific ethics that are applicable to the kind of citizen science projects Virginia Master Naturalists might do. 1. First, keep good records of your work. This includes documenting your time and projects in the Volunteer Management System, but it also includes keeping additional field notes about what you did, when, and where. 2. Second, be aware that citizen science projects typically have defined protocols and procedures that you must follow for your data to be meaningful. Many citizen science projects rely on all participants collecting data in the same way so that the data can be pooled together and compared. Follow directions, and ask questions if you aren't sure about the right way to do something. 3. Never fabricate or falsify data. In the field, it is tempting to take a guess at an identification that you really aren't sure about, to take some shortcuts on measurements, or to fill in data that you forgot to collect. You might feel like your actions in this regard aren't important, but they are! Citizen science data need to be as trustworthy as data collected by professional scientists. 4. Sometimes _not_ finding a species is just as important as finding it. It's important to report negative data as well as positive, unless that is not part of the project protocols. So, if you conduct a butterfly survey but don't find any butterflies, you should still report on your work. 5. Return all data, whether negative or positive, to the designated project leads so that you can be sure it is used for its intended purpose. If you collect data in the field but then never report it or use it, you really haven't

Slide 44 Thanks for joining us! A special thanks goes to Alycia Crall who co-authored the citizen science curriculum. Thanks also to our funders and to those individuals and organizations contributing images.