Handouts
The following pages include handouts that you may find useful in your outreach efforts on the topic of gardening in a warming world:

- ☐ Handout#1 – ***Being a Systems Thinker***
  This 2-page handout is adapted from author Linda Booth Sweeney's *12 Habits of Mind* lists the key characteristics of a systems thinker on one page and pictures on the next.
- ☐ Handout #2 – ***Knowing your Garden System***
  This 2-page handout is a checklist of ways to map your garden landscape.
- ☐ Handout #3 – ***What is the Greenhouse Effect?***
  These images on a 1-page handout depict the general concept of how greenhouse gases warm the planet.
- ☐ Handout#4 – ***What Happens in New York State When the Climate Changes?***
  This 1-page handout provides an image of warming indicators and lists a the variety of NYS climate change impacts.
- ☐ Handout#5– ***Reliable Resources Matrix***
  This 2-page worksheet provides a tool to document and quantify the value of each resource, how accurate it is, and how reliable.
- ☐ Handout #6 – ***Climate-smart gardening put into action***
  This 4-page worksheet has a list of actions to reduce your carbon footprint. Reflect on their contribution to mitigation or/and adaptation.

Other resources can be downloaded for free at climatechange.cornell.edu/gardening

- Climate Smart Gardening Course Book
- Facilitator's Notebook (this document)
- Companion presentation
- Presentation notes

Being a Systems Thinker

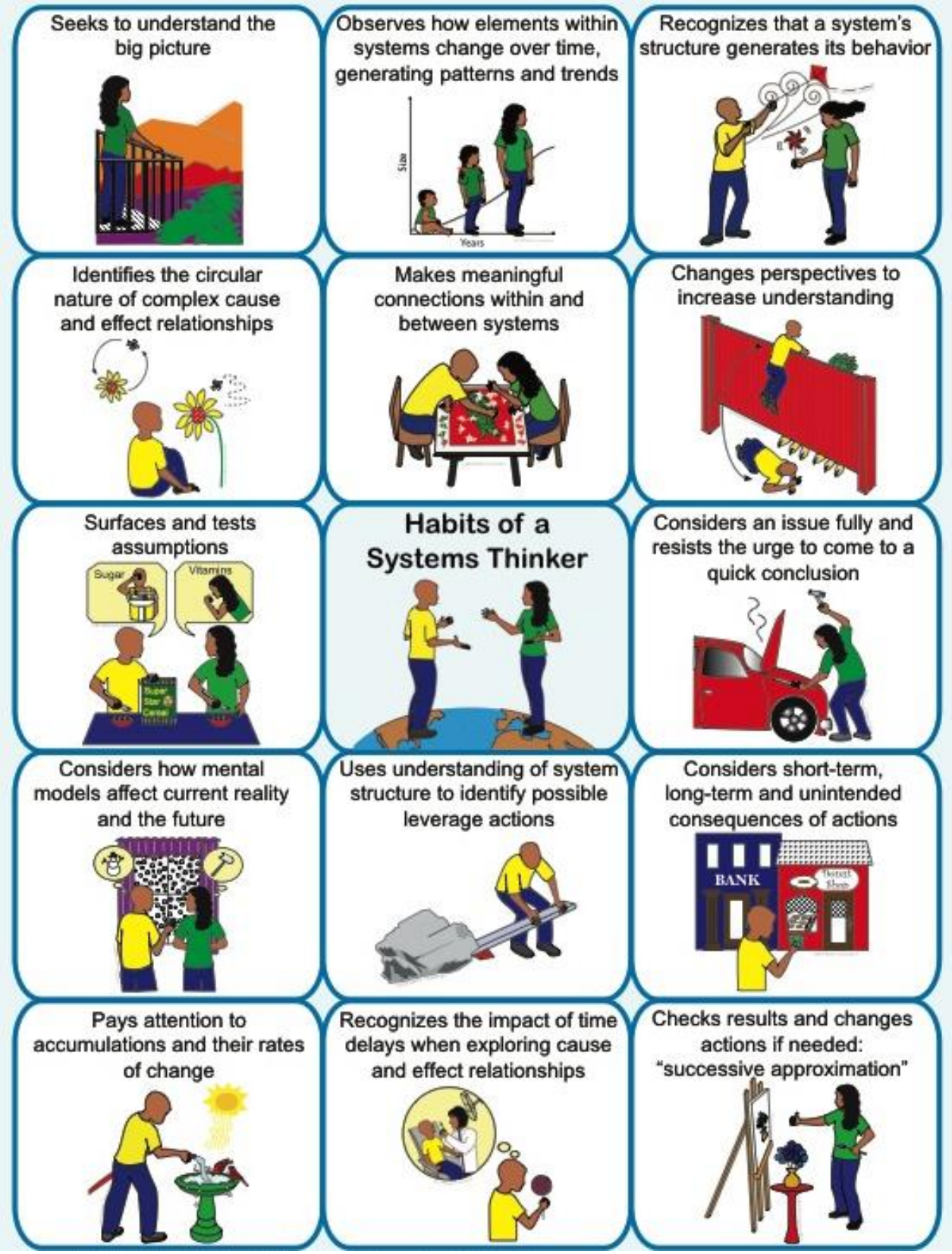
Systems thinking considers the formulation, diagnosis, and resolution of issues that arise from complex forms of interaction in systems. Different parts of a system are so interconnected that if we alter one part of a system it will change other parts. Fundamentally, systems thinkers focus on wholes rather than on parts. Within the context of the whole, they concern themselves with relationships more than objects, and with networks more than hierarchies.

A Systems Thinker:

- Sees the whole: sees the world in terms of interrelated "wholes" or systems, rather than as single events, or snapshots.
- Looks for connections: assumes that nothing stands in isolation; and so tends to look for connections among nature, ourselves, people, problems, and events.
- Pays attention to boundaries: "goes wide" (uses peripheral vision) to check the boundaries drawn around problems, knowing that systems are nested and how you define the system is critical to what you consider and don't consider.
- Changes perspective: changes perspective to increase understanding, knowing that what we see depends on where we are in the system.
- Looks for stocks: knows that hidden accumulations (of knowledge, carbon dioxide, debt, and so on) can create delays and inertia.
- Challenges mental models: challenges one's own assumptions about how the world works (our mental models) — and looks for how they may limit thinking.
- Anticipates unintended consequences: traces loops of cause and effect and always asks "what happens next?"
- Looks for change over time: sees today's events as a result of past trends and a harbinger of future ones.
- Sees self as part of the system: looks for influences from within the system, focusing less on blame and more on how the structure (or set of interrelationships) may be influencing behavior.
- Embraces ambiguity: holds the tension of paradox and ambiguity, without trying to resolve it quickly.
- Finds leverage: knows that solutions may be far away from problems and looks for areas of leverage, where a small change can have a large impact on the whole system.
- Watches for win/lose attitudes: knows dichotomous attitudes usually make matters worse in situations of high interdependence.

This listing is adapted from ***Thinking About Systems: 12 Habits of Mind*** by Linda Booth Sweeney, online at: http://www.lindaboothsweeney.net/thinking/habits

Being a Systems Thinker



Knowing <u>your</u> Garden Systems

Mapping a garden landscape is a common approach that utilizes systems thinking. A base map with overlays can shift focus from the parts to the whole and be a tool for considering relationships, connectedness, and context that are the essence of systems thinking. These maps need not be professional drawings or elaborate. Sketches with colored pencils on graph and tracing paper will do. Take some time to try to create some maps of a real garden place. It may be a landscape on a property you or friends or relatives own or rent; a community garden; a school garden; or another public space you can access.

Base map

An accurate base map is the result of a series of direct field observations of your site. Using colored pencils and graph paper draw the property to scale. Include on the base map footprints of houses or buildings; driveways, paths, decks, patios or other hardscape features; utility lines; an arrow pointing North; and the scale of the map (e.g. 1 foot in real life = 1/4 inch on graph paper).

Soil map

Using tracing paper over the base map, outline the following characteristics: › Areas of erosion and compaction › Low areas that are commonly wet › Exposed rock › Shallow soils › Areas where the soil abruptly changes texture or structure > pH or soil test results, which include:

- ☐ Texture, structure, consistence profile, drainage
- ☐ Topsoil Fertility: pH, % OM (organic matter), N, P, K, Ca
- ☐ Toxins: lead, mercury, asbestos, cadmium

Water map

- ☐ Existing sources of supply: location, quality, quantity, dependability, network
- ☐ Watershed boundaries and flow patterns: roof runoff, driveway and road runoff, storm drains, flood- prone areas, vernal pools or temporary ponds
- ☐ Pollution sources: autos, neighbors, nearby commerce, industry or farms, entry points on the site
- ☐ Potential sources of water supply: location, quality, quantity, cost to develop
- ☐ Existing infrastructure: on site & nearby culverts, wells, water lines, tanks, sewage lines, septic tanks, leach fields, cisterns
- ☐ Erosion: existing and potential
- ☐ Domestic sources: wells, streams, ponds

Vegetation map

Your gardening experiences no doubt has already shown that you need to know the characteristics/cultural needs of each species of plant you have in your garden. My lavender plants for example, didn't like the small space I gave them, and let me know when their roots were too wet. Mapping out the following characteristics will help you to understand the present needs and plan for the future as conditions change.

- ☐ Existing Plant Species: locations, size, quantity, patterns, uses
- ☐ Habitat Types: food/water/shelter availability
- ☐ Animal Species: domesticated, wildlife, pests
- ☐ Old Trees
- ☐ Established Communities
- ☐ Invasive/Non-native
- ☐ Rare/Medicinal Plants
- ☐ Native Species

Knowing <u>your</u> Garden Systems

Light, air flow, temperature map

Make note of your regional climate and the micro-climate of your own back yard. Identify the hardiness zone for your region. Note your observations of the beginning dates of seasons. Where does the wind usually blow in your yard, how much sunlight does your garden get, and at what time of day?

- ☐ Plant Hardiness Zone
- ☐ Annual Precipitation, Seasonal Distribution
- ☐ Latitude
- ☐ Wind: prevailing, seasonal, storms, effect on vegetation, change with time of day
- ☐ Frost free dates (average, extremes)
- ☐ Fire: evidence of former fires, direction, pyriscent (fire-loving)-species, hazardous areas
- ☐ Flood: evidence, vulnerable areas, use for capturing/storing energy
- ☐ Temperature Fluctuations
- ☐ Sunshine
- ☐ Weather patterns, including precipitation and fog

Example: Basemap

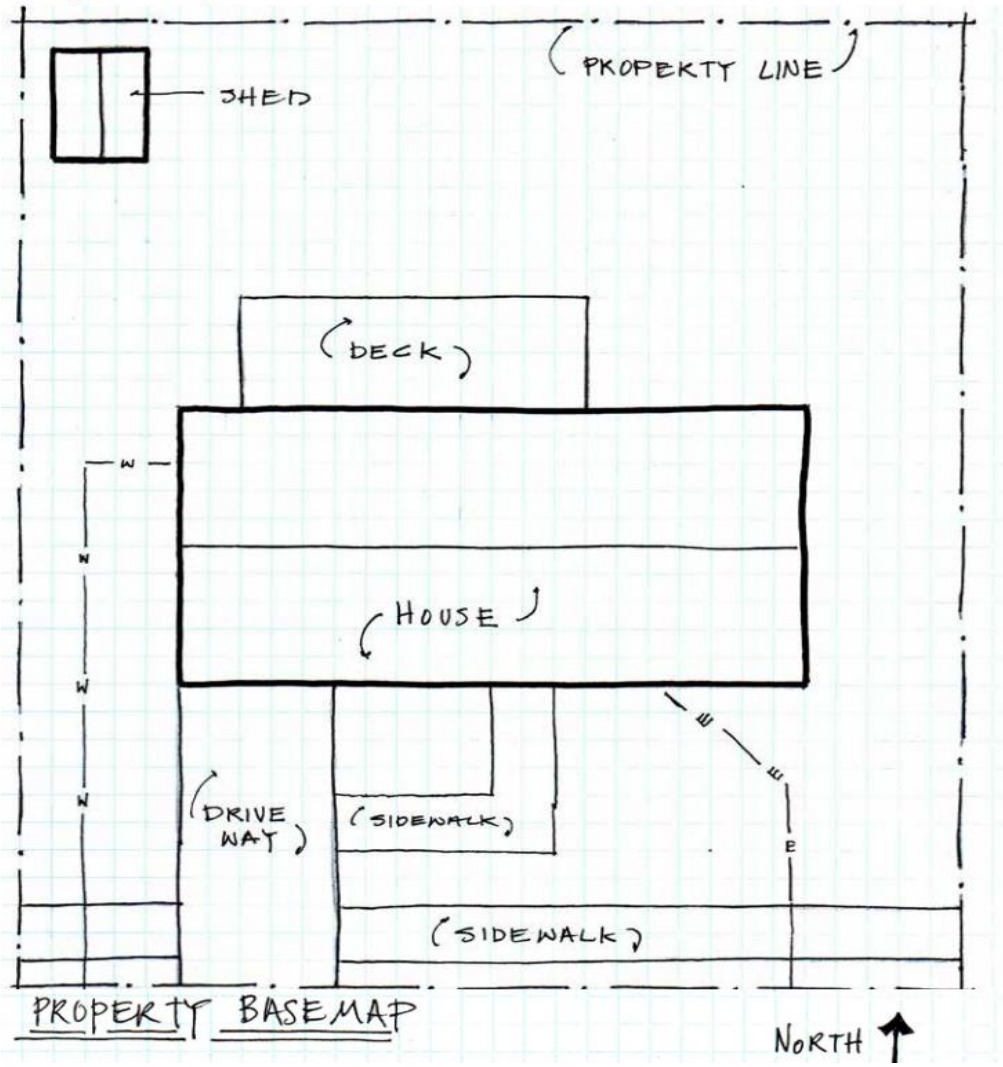
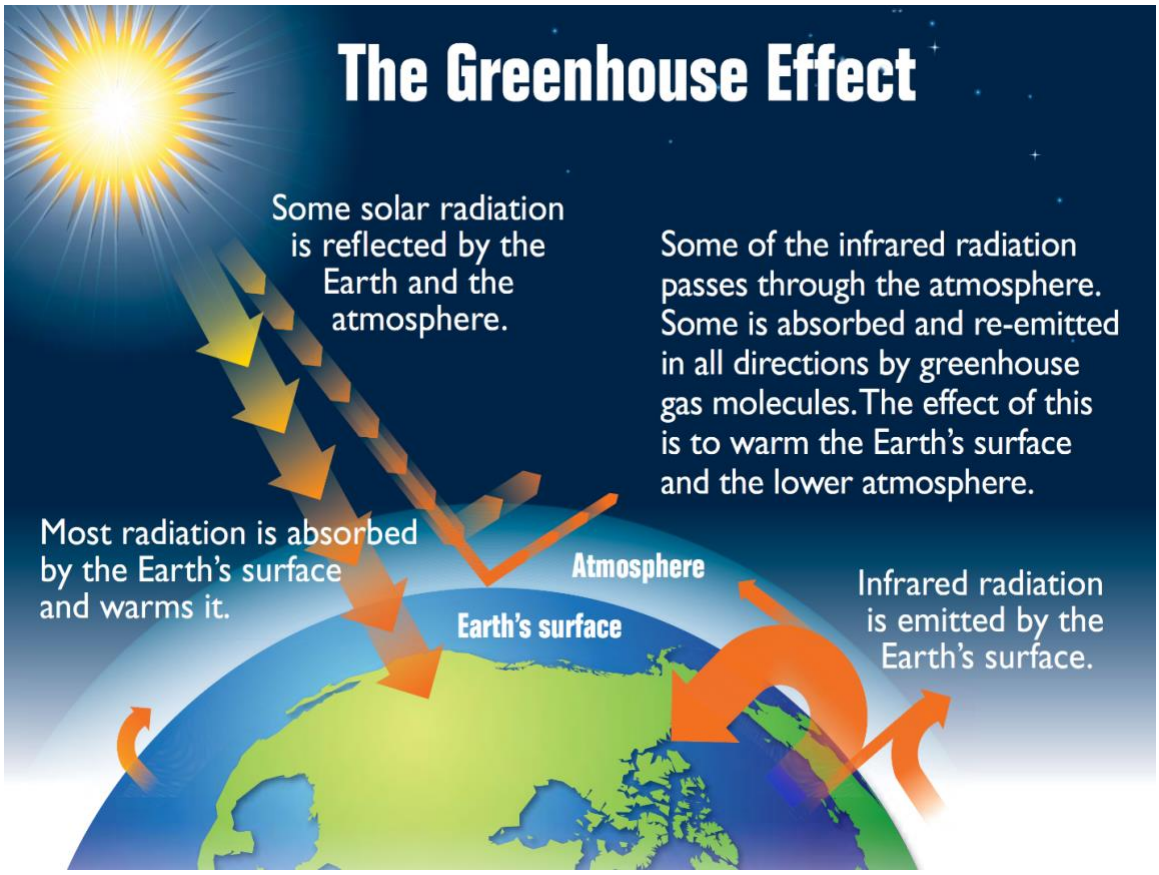
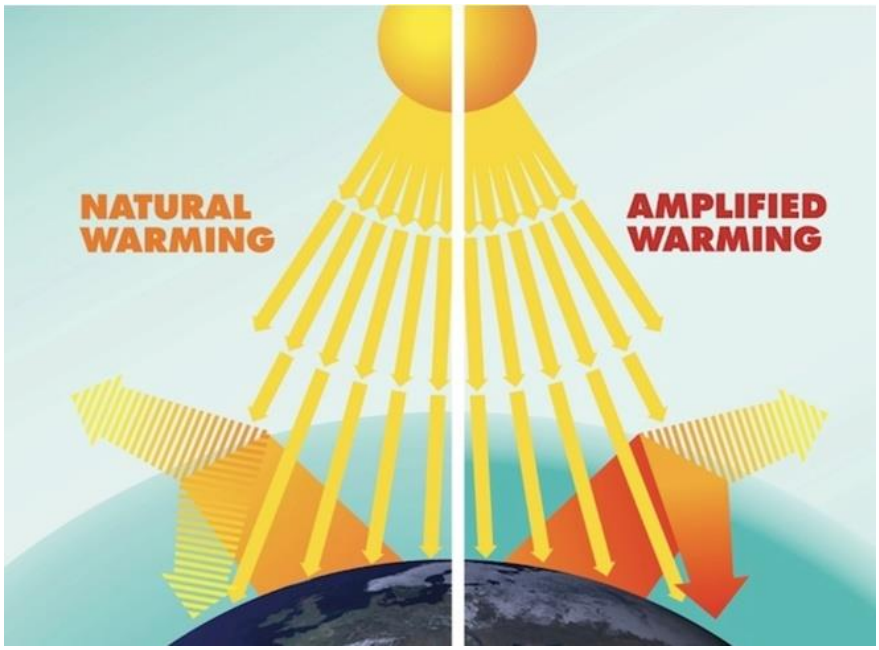


Image from Landscape for Life Manual; https://landscapeforlife.org/

What is the Greenhouse Effect?



Course Book Figure 6. The Greenhouse Effect. Image credit: US Environmental Protection Agency. [1]

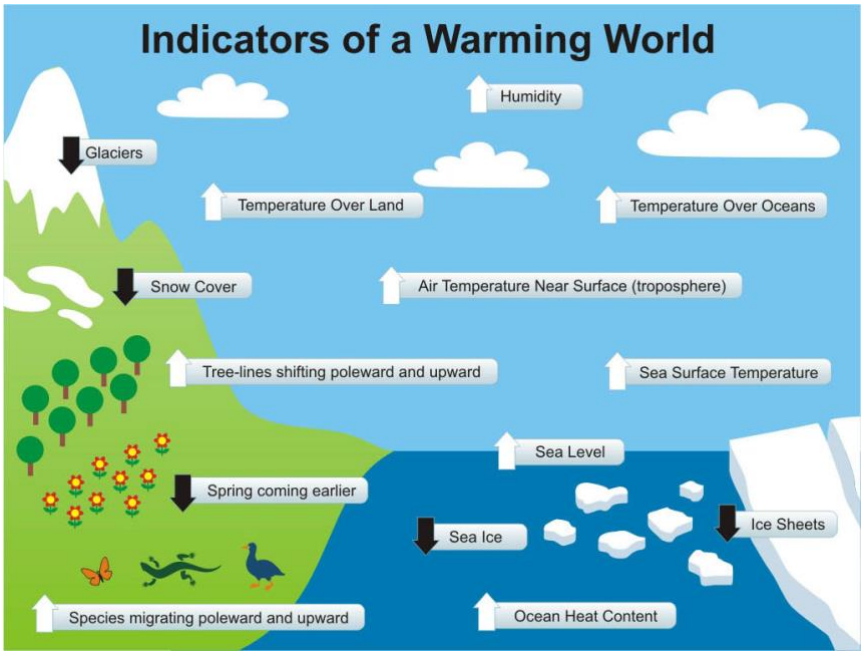


Presentation Figure on Slide 17. Image credit: U.S. Global Change Research Program.[2]

[1]US EPA. 2012. The Greenhouse Effect. Accessed Sept 2018 from https://commons.wikimedia.org/wiki/File:Earth%27s_greenhouse_effect_(US_EPA,_2012).png
[2]U.S. Global Change Research Program. 2009. Climate Literacy: The Essential Principles of Climate Science. Retrieved 31 July 2017. https://www.climate.gov/teaching/essential-principles-climate-literacy/essential-principles-climate-literacy

What Happens in New York State When the Climate Changes?

The videos found at Climate Learning Network will offer climate change basics in a very clear and concise manner: http://www.climatelearning.net/e-learning-modules/



Course Book Figure 9. Indicators of a Warming World. Image credit: www.skepticalscience.com [1]

Observing Climate Change Impacts in New York[2]

New York's ClimAID report (2011, 2014), the National Climate Assessment (2014), and other research show that a variety of climate change impacts have already been observed.

Temperature

- The annual average temperature statewide has risen about 2.4°F since 1970**,** with winter warming exceeding 4.4°F. This equals about 0.25°F per decade since 1900.
- Annual average temperatures have increased across the state.

Precipitation

- Overall, average annual precipitation has increased across New York State since 1900, with year-to-year (and multiyear) variability becoming more pronounced**.**
- New York is getting more precipitation in the winter and less precipitation in the summer.
- Between 1958 and 2010, the amount of precipitation falling in very heavy events (downpours) increased more than 70% across the northeastern United States.

Sea-level rise

- Sea levels along New York's coast have already risen more than a foot since 1900**.**
- New York's rate of rise (about 1.2 inches per decade) is almost twice the observed global rate (0.7 inches per decade) over the same period.

Natural resources

- Spring begins a week earlier than it did a few decades ago; the first leaf date is more than 8 days earlier & the first bloom date is more than 4 days earlier than in the 1950s.
- Winter snow cover is decreasing.
- Pollinating bees in the northeastern US arrive about 10 days earlier than in the 1880s.
- NY breeding bird & ocean fish population ranges have shifted northward over the last decades.

[1]US EPA. 2012. The Greenhouse Effect. Accessed Sept 2018 from https://commons.wikimedia.org/wiki/File:Earth%27s_greenhouse_effect_(US_EPA,_2012).png
[2]NYSDEC Impacts of Climate Change in New York World. Accessed September 17, 2018 from https://www.dec.ny.gov/energy/94702.html

Reliable Resources Matrix – Example

➢ **Title of Resource:** The Climate Conscious Gardener by Janet Marinelli, Editor						
	1	**2**	**3**	**4**	**5**	**Rating**
Who? – The author's experience with this area.	Author background is unknown.	Little evidence – a few or minor publications in this area.	Some evidence – more than a few/minor publications in this area.	More evidence – several publications in this area.	Author is known authority in this area. Former Director of the Brooklyn Botanical Garden	5
What? – Are the points relevant to our needs or tasks?	No, little, or marginal relevant points.	Some relevant points.	Several relevant points.	Numerous relevant points. Book offers many strategies for sustainable climate change gardening	Content and points closely match our needs or tasks.	4
Where? – Context/situation of content is similar to ours?	Situation is different.	Minimal similarities.	Some similarities.	Number of similarities. Book offers examples I can use for my vegetable gardening	Context/ situation matches ours.	4
When? – Publication date.*	Date is not clear or older than 20 years.	10 to 20 years old.	5 to 10 years old. Written in 2010	2 to 5 years old.	Published or updated in the last 2 years.	3
Why? – Reasons or purpose of article?	No apparent motive.	Opinion based publication.	Trade magazine or commercial publication.	News or information publication lacking specific research based references.	Peer reviewed publication with research based references cited.	5
Total Score	→	→	→	→	→	21

Provide a few sentences to summarize the content of this resource:

This book offers gardeners specific techniques for mitigating climate change and adapting to climate impacts in their back-yard gardens. It is very reader friendly and has numerous helpful graphs and photos. I found the chapter on reducing your garden's carbon emissions very useful and interesting.

In which of the following **category** would you put this resource? (Choose the ONE BEST fit).

Climate Science	Adaptation Measures	X Sustainable/Gardening
Climate Status Report	Mitigation Methods	Other (specify)

Reliable Resources Matrix - Worksheet

Title of Resource:						
	1	**2**	**3**	**4**	**5**	**Rating**
Who? – The author's experience with this area.	Author background is unknown.	Little evidence – a few or minor publications in this area.	Some evidence – more than a few/minor publications in this area.	More evidence – several publications in this area.	Author is known authority in this area.	
What? – Are the points relevant to our needs or tasks?	No, little, or marginal relevant points.	Some relevant points.	Several relevant points.	Numerous relevant points.	Content and points closely match our needs or tasks.	
Where? – Context/situation of content is similar to ours?	Situation is different.	Minimal similarities.	Some similarities.	Number of similarities.	Context/ situation matches ours.	
When? – Publication date.*	Date is not clear or older than 20 years.	10 to 20 years old.	5 to 10 years old.	2 to 5 years old.	Published or updated in the last 2 years.	
Why? – Reasons or purpose of article?	No apparent motive.	Opinion based publication.	Trade magazine or commercial publication.	News or information publication lacking specific research based references.	Peer reviewed publication with research based references cited.	
Total Score	→	→	→	→	→	

Provide a few sentences to summarize the content of this resource:

In which of the following **category** would you put this resource? (Choose the ONE BEST fit).

Climate Science	**Adaptation Measures**	X **Sustainable Gardening**
Climate Status Report	**Mitigation Methods**	**Other (specify)**

Climate-smart gardening put into action

The list below provides steps that may improve the climate IQ of your garden; this includes actions to reduce your carbon footprint. Consider each and check the box if the action is adaptation, mitigation or both. As you consider each use the additional space to record comments, questions, or caveats.

Action	Is this adaptation?	Is this mitigation?
Experiment with new species New climate conditions are already shifting plant hardiness zones creating an opportunity to successfully grow species and varieties that previously would not thrive. Projected longer periods of high heat accompanied by low precipitation may also require a shift to more drought-tolerant plant varieties.	☐	☐
Move up planting Take advantage of a longer growing season by setting an earlier start date for planting cold sensitive annual vegetables and flowers.	☐	☐
Manage water Rain is predicted to fall in more intense events, which can cause plants to have "wet feet" and root disease. Identify where water pools in low spots and reconfigure your garden for better drainage. Use soil amendments to improve drainage during wet periods or to improve water-holding capacity during dry periods. Also consider rain barrels and drip irrigation to collect water and redistribute water to specific locations.	☐	☐
Protect plants against frost When spring temperatures come sooner than usual, trees and shrubs can leaf out earlier, making them vulnerable to spring frost. Avoid planting on north-facing slopes and low-lying shaded areas that are more subject to frosts. Consider strategies such as reusable fabrics to cover plants when frost is likely.	☐	☐
Be aware of invasive threats Higher temperatures are predicted to bring increased weed, insect, and disease pressure. Contact your Cooperative Extension experts to stay informed about new pest.	☐	☐

Climate-smart gardening put into action

The list below provides steps that may improve the climate IQ of your garden; this includes actions to reduce your carbon footprint. Consider each and check the box if the action is adaptation, mitigation or both. As you consider each use the additional space to record comments, questions, or caveats.

Action	Is this adaptation?	Is this mitigation?
Attract native pollinators Insects are essential to the reproduction of most flowering plants. Climate change impacts may cause some plants to shift when they produce flowers, and other plants to grow poorly. Aim to support a variety of pollinating insects by providing nectar throughout the growing season. Choose a palette that blooms from spring to summer to fall with multiple species of flowering plants that bloom at the same time. If one fail to thrive others will be available for pollinators. This is called *functional redundancy*.	☐	☐
Stay flexible While there are projections for climate change in the future, there are many unknowns including the variability of plant responses to environmental changes. One way to be prepared for unpredictability is to include a diverse mix of plants. Pay attention to what plants are doing well and consider what qualities are allowing them to thrive.	☐	☐
Green roofs Growing turf and plantings on a (flat) roof top, or creating a roof-top patio garden is a way to increase the green space in your dwelling. Trees and shrubs serve as carbon sinks, that is, they absorb carbon dioxide. A green roof can also absorb heat and lower the summertime temperatures of a building. Added green space means urban apartment dwellers can grow veggies on the roof top of their apartment building, or garage.	☐	☐
Container gardening Growing plants, trees and vegetables in containers can increase the amount of green surrounding your dwelling; especially apartments or condos. Using repurposed or containers made of recycling material might be another way of lowering your garden's carbon footprint.	☐	☐

Climate-smart gardening put into action

The list below provides steps that may improve the climate IQ of your garden; this includes actions to reduce your carbon footprint. Consider each and check the box if the action is adaptation, mitigation or both. As you consider each use the additional space to record comments, questions, or caveats.

Action	Is this adaptation?	Is this mitigation?
Xeriscaping Conserving water is a key principle of xeriscaping, which is accomplished by a garden design that includes a wide range of drought resistant plants, and landscapes materials that require no irrigation. For example, gravel or mulch create the spacing between planting beds, rather than grass.	☐	☐
Permaculture Applying this garden and social design process involves simulating or directly utilizing the patterns and features observed in natural ecosystems in your specific region.	☐	☐
Rain garden This garden maintains the integrity of the soil by preventing erosion and protects water ways by slowing down, or eliminating run-off.	☐	☐
Meadow lawn Replacing a lawn with native grasses and wildflowers reduces the need for use of fossil-fuel burning power equipment to maintain the lawn. It will also be attractive to insects and wildlife that support a healthy ecosystem.	☐	☐
Raised bed gardening Raising the level of the soil above the surface can improve the health of your plants and thereby increase their ability to store carbon dioxide. It also can decrease the chance of water logging in low areas that may be prone to flooding or ponding.	☐	☐
Composting Composting organic matter from mowing, pruning, weeding, and food waste would reduce fossil fuel consumption used to transport your waste off-site and would prevent the production of methane that occurs when organic matter is buried in a landfill.	☐	☐

Climate-smart gardening put into action

The list below provides steps that may improve the climate IQ of your garden; this includes actions to reduce your carbon footprint. Consider each and check the box if the action is adaptation, mitigation or both. As you consider each use the additional space to record comments, questions, or caveats.

Action	Is this adaptation?	Is this mitigation?
Use your finished compost Using your finished compost as mulch or mixing it into the garden or potting mix contributes nutrients and beneficial organisms to soil life. The additional organic matter can also enhance soil's water holding capacity and carbon sequestering.	☐	☐
Mulch in place grass clippings & leaves Leaving cut grass blades in place lowers fertilizer needs as they are mostly water and nutrients. Lawn health is not compromised when tree leaves that drop on the lawn in the fall are chopped finely enough to slip between grass blades to soil surface.	☐	☐
Add your action ideas…		
	☐	☐
	☐	☐
	☐	☐