4-H Science 101:

Development, Delivery and Assessment of 4-H Science Programs

PEER REVIEWED

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4-H Science 101:

Introduction to the Development, Delivery and Assessment of 4-H Science Programs

Goal

Enable staff to identify the resources, tools and skills necessary for delivering quality 4-H Science programs.

Objectives

1. Prepare staff to:
    a. Frame programs that intentionally target 4-H Science outcomes and incorporate evaluation strategies to assess impact.
    b. Train staff to effectively deliver 4-H Science programs in a positive youth development context.
    c. Train staff to develop 4-H Science programs that meet the criteria on the 4-H Science Checklist.
2. Provide an opportunity for a team assessment that will expose the group needs and future action steps.

Facilitators

Best delivered by multiple facilitators who alternately provide instruction and guide the processing in each section. Sections are sequentially designed and all reinforce the 4-H Science Check List and Logic Model. Two facilitators are recommended for groups of 25, as your group size increases; plan to add more facilitators accordingly.

Intended Scope

Four-hour program best delivered to approximately 25 participants. Space: a large room with round tables that will accommodate 8 stations around the outside walls of the room. Larger groups are accommodated by additional facilitators and additional space for group activities.

Intended Audience

Staff with program development, delivery and evaluation and/or professional and volunteer development roles.

Key Messages

When you are not in the role of the lead facilitator, support the lead facilitator by using the key messages on the agenda to ensure that key pieces are covered, input is provided, and processing takes place. See the questions/comments next to each section. This information enables you to embed the processing strategies and intentionally address the objectives through questions and examples.

Assessment

Pre-assessment ranks the comfort level of individuals with the specific content areas. This is for the facilitators to better understand the audience and effectively plan the training. It also provides opportunities for participants to begin thinking about the content of the training. Post assessment ranks the understanding of teams to accomplish the objectives above, recognize the gaps and identify the next action steps.

Appendices

Appendix A: Pre-Assessment
Appendix B: 4-H Alumni Bios
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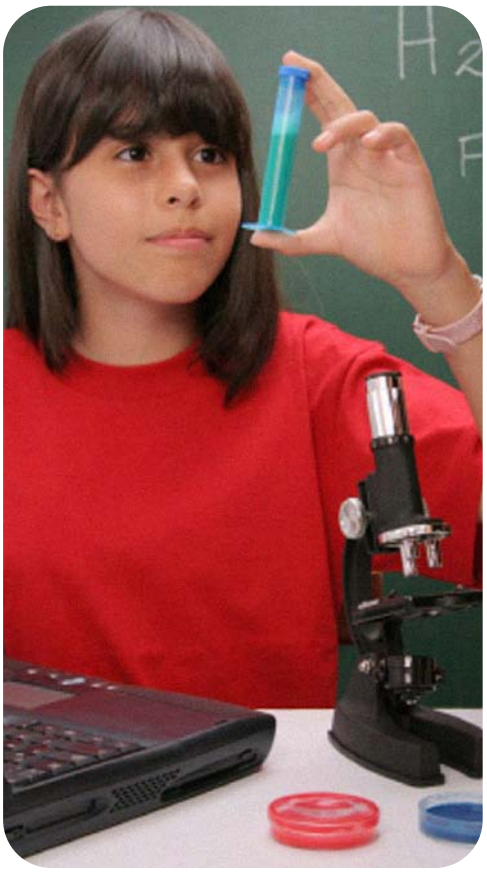


4-H Science 101-

Creating, Supporting, and Sustaining 4-H Science Ready Programs

How do your local program efforts align around 4-H Science? Participate in hands-on learning experiences and explore the 4-H Science framework that will help you intentionally connect professional development, evaluation and curriculum in your 4-H Science local program.

AGENDA

Program Practice	Activity	Embedded Process/ Key Messages
Objective	**Graffiti Walk and Introductions–** *10 minutes* Participants explore why we do 4-H Science program with youth. Real examples are used to show how alumni have given 4-H credit for pursuing science in their lives, their choice of careers, and the accomplishments they have made i.e. developing standards for field protection; working on a cure for cancer; being involved in the space program and helping preserve the environment while growing healthier food. *Handout* – 4-H Alumni Bios	• Sparking the interest in science can make a difference in people's lives. • People who have been touched by science in 4-H have made a difference. • Interest in 4-H Science starts by touching the life of a young person. • What makes 4-H Science critical in your community? .

AGENDA

Program Practice	Activity	Embedded Process/ Key Messages
Objective 1a: Frame programs that intentionally target 4-H Science outcomes and incorporate evaluation strategies to assess impact. **Objective 1c:** Train staff to develop 4-H Science programs that meet the criteria on the 4-H Science Checklist.	**Intentional Framework–** *25 minutes* Participants become familiar with the 4-H Science Checklist and give examples of how they already do many of these things in their science programs. The focus is on the components and how having an intentional framework guides the initiative nationally. *Handout* – 4-H Science Checklist	• 4-H Science is the combination of the context of youth development and the content of science. • It is purposeful—begin with the end in mind. • Math is applied in 4-H Science. • NSES Standards and 4-H Science Abilities include engineering and technology.
Objective 1a: Frame programs that intentionally target 4-H Science outcomes and incorporate evaluation strategies to assess impact.	**Intentional Learner Outcomes–** *30 minutes* Participants think about a youth they work with or one they would like to work with and outline the short and long-term outcomes they would like for this young person as it relates to Science. Refer to 4-H Science Logic Model Handout. BREAK – 10 MINUTES	• Focus on outcomes for a young person not outputs. • Outcomes are sequential. • Know your capacity for influence. • Begin with the end in mind.

AGENDA

Program Practice	Activity	Embedded Process/ Key Messages
Objective 1b: Train staff to effectively deliver 4-H Science programs in a positive youth development context. **Objective 1c:** Train staff to develop 4-H Science programs that meet the criteria on the 4-H Science Checklist.	**Wind Energy–** *65 minutes* Participants have an opportunity to experience a 4-H Science activity and analyze the learning components. Processing includes thinking through the 4-H Science Checklist components in relation to the activity they experienced.	• Look for opportunities to embed evaluation. • Activity needs to be delivered by competent facilitators. • An activity is only one part of a program. • A well-developed activity is written with the 4-H Science Checklist criteria in mind, but in most cases would not achieve the necessary frequency, intensity or duration for achieving outcomes. • An activity is ideally embedded within a continuum of learning on a given topic.
Objective 1a: Frame programs that intentionally target 4-H Science outcomes and incorporate evaluation strategies to assess impact.	**What About Learner Outcomes?–** *20 minutes* Participants determine the indicators for the intended outcomes of their 4-H Science programs and explore strategies for collecting information for reporting and reprogramming. BREAK – 10 MINUTES	• Identify the indicators. • Think creatively about assessment strategies. (Remember the audience is youth.) • Ask what is needed. • Utilize data for reporting and reprogramming.

AGENDA

Program Practice	Activity	Embedded Process/ Key Messages
Objective 1b: Train staff to effectively deliver 4-H Science programs in a positive youth development context.	**Competent and Confident 4-H Science Facilitators–** *50 minutes* Participants have an opportunity to: determine the competency that they think is most significant/important; hear more about the significance of the balance between content and context in 4-H Science Programming, and think through the indicators for the competencies and how they might be used. *Handouts:* Competencies; competency cards; competency self-assessment tool; one page context – content sheet.	• Based on the Essential Elements framework. • Focus on youth development and 4-H Science (like the checklist). • The self-assessment tool and cards are indicators for the competencies. • Point out that tools can be used for identifying needs and creating a professional development plan.
Objective 2: To experience a team assessment that will expose the group needs and future action steps.	**Closure/Assessment–** *20 minutes* Participants complete a written assessment to consider where the strengths and gaps still are in their work with 4-H Science. *Handout:* Post-Assessment	• All ideas are good ones. • This is our road map. • Learning and improvement is an ongoing process.

Making the Case- Grafitti Walk

Purpose:

- Identify the need for 4-H Science.

Time:

10 minutes

Materials:

- Cases posted around the room of key science discoveries or tools that would not have happened without people knowledgeable in science areas.
- Examples of 4-H Alumni in Science (Appendix B)

Trainer Notes:

STEP 1: INTRODUCE ACTIVITY

Graffiti Walk– Before the workshop begins and during about the first 5 minutes.

As participants walk in the room and at the very beginning of the workshop, ask participants to write on a flip chart paper that has key science discoveries or tools that have changed the way we are able to live and excel in the world today. The question on each chart is—"How would the world be different?"

What would be different…if we had no standards for fire protection?

What would be different….if we had a cure for ovarian cancer?

What would be different…if we had no space program?

What would be different….if we could preserve the environment while growing more/healthier food?

Once there are comments on the charts, ask for a representative for each of the four areas to share how they think the world might be different without key discoveries.

STEP 2: REFLECT

Looking at the charts around the room, how do you think our lives might be different without these discoveries?

What might have motivated these same people when they were children and youth to be able to accomplish these discoveries in their lives?

What does that have to do with why we are all in this room today?

Actually, 4-Hers make these discoveries and ongoing investigations—4-H er's who got turned onto science. How many more youth can we, together, intentionally reach and excite about explorations in science?

Handout the examples of the successful 4-H Alumni in the sciences (Appendix B). Have people glance at it and, if time permits, ask for a couple comments about what they notice on the pages.

STEP 3: TRANSITION

As a youth development organization we want to think about both the context—youth development—and the content—4-H Science—as we work with youth.

Let's spend some time together becoming familiar with critical components of the framework for 4-H Science.

Intentional Framework/ Checklist

Purpose:

- Discuss the framework created by 4-H to address the need for 4-H Science.

Time:

25 minutes

Materials:

- Agenda Handout
- 4-H Science Checklist Handout (Appendix D)

Trainer Notes:

STEP 1: AGENDA AND 4-H FRAMEWORK

The next four hours will be an exploration into how we, in 4-H, have created a national framework and how we can think intentionally about 4-H Science programming. Together we want to make sure that children and youth have opportunities to increase their excitement and expand their skills, perseverance and knowledge about 4-H Science—so that great discoveries can continue to shape the world. Saving our planet, solving practical problems, voting with a strong background in science literacy, or contributing accomplishments that can be seen around this room are dramatic ways we make changes in our world.

Put the agenda on flipchart, Power Point or use as a handout. Walk through the elements of the agenda and briefly describe what will happen in each one.

Remember that the outcome for this session is to assist you in identifying integral components of a framework that supports intentional outcomes of 4-H Science. Let's examine the agenda and focus for a moment on key framework pieces and connections among components: curriculum, evaluation and professional development.

STEP 2: INTRODUCE CHECKLIST

In 4-H, we call our initiative 4-H Science (which includes science, engineering, technology and applied math). Knowing that math is the language that helps articulate each of the other areas and that is applied in each, we don't intentionally have projects that support math in 4-H.

Our National 4-H Science Initiative is designed to reach 1 million additional youth, particularly those who are underrepresented in these areas, by the year 2013. We, along with you, have looked at national and global needs and have articulated ways that we, as the largest national youth organization, can assist in meeting those needs. We have determined there are key components that are critical to our work as we strive to increase science awareness, abilities, interest, knowledge, and aspirations. This all evolves directly from the first activity. We want youth to get excited, skilled and inspired in science because each person can make a difference in any number of ways.

The 4-H Science Checklist that was just handed to you is an intentional and tangible way that we have chosen to move our 4-H Science Initiative forward. Each component is critical to how we do 4-H Science and may be relevant to how you do your 4-H Science program as well. Although each organization may have different items and could be concerned with addressing different identified needs, it is critical that we all be purposeful in our choices. What we found important was to identify the specific program components that were critical to our efforts and provide the scaffolding for curriculum, professional development, and evaluation.

STEP 3: PARTICIPANTS DISCUSS CHECKLIST

At tables—assign 1–3 of the components to each table to discuss (depending on the number of participants). Have each table discuss what it is; how they already are doing this in their own programs and be prepared to report back to the room. Give them about 8–10 minutes to discuss or watch for when the groups seem to be ready to report back.

STEP 4: REPORT BACK

As groups report back, point out key areas that you want to draw attention to that don't come up i.e.— some states have state standards as well; much of this is not just specific to 4-H Science but any of our youth development program we do. Use the Trainer Resource - Appendix E for additional information on each component of the checklist.

STEP 5: USING THE CHECKLIST

Now, in glancing over this checklist, think about how you would take it back to your locality and use it to frame discussions around building more intentional frameworks for your program efforts.

- **Which items do you think would be identified as most important?**
- **What additional items might your locality add to this checklist?**

STEP 6: TRANSITION

This is just one of the tools that scaffold our 4-H Science Framework. Now we are going to talk further about outcomes—the ones you will see on the logic model and how you consider outcomes in your own 4-H Science work.

Intentional Learner Outcomes

Purpose:

- Identify one key learner outcome for their 4-H Science work.

Time:

30 minutes

Materials:

- 4-H Science Logic Model (Appendix F)
- ½ sheets of paper

Trainer Notes:

STEP 1: LOGIC MODEL

Handout and refer to the 4-H National Science Logic Model.

As you look at the logic model, what is one thing you notice? (If they don't seem to notice the linkages that move from the short-term learning to the behavior to the long term—make a point of bringing this out.)

In what ways would this logic model work for you in your own 4-H Science work?

Which of the outcomes relate to the intended outcomes of your own work?

In what ways would you need to make changes? What outcomes do you have that are unique to your specific audience or location?

STEP 2: IMAGINE A CHILD – AN OUTCOME

I want you to take a minute and imagine a child or young person who is involved in one of your programs or could potentially be reached by one of your existing or future programs.

Take one of the pieces of papers in front of you and I want you to describe this person in words or in a drawing. Are they a boy or girls, how old is he or she, where does he or she go to school, what are his or her likes or dislikes?

After a minute or so of silence, have one or two people describe his/her description.

At this point you have identified a potential audience member who could be impacted by your programs.

Now imagine this child or young person has just successfully completed your program and answer these three questions.

Have key words that are in bold from the questions on flipchart so participants have them to refer to as they work on this.

What does this child now know, what skills have they developed or what attitudes have evolved?

What would you hope they do or achieve as a result of what they know?

How could this impact the conditions of their life and potentially of others?

Turn your sheet of paper over and write what "outcomes" you hope are achieved for the child.

Ask a couple people to share—or go through each of the areas—1–3 and ask for volunteers to share in just one area.

The answers to these questions describe the short, intermediate and potential long-term impacts of your work.

Now keeping these outcomes in mind, let us have a little fun with science.

Wind Energy

Purpose:

- To identify key components of 4-H Science learning activities.

Time: 65 minutes

Materials:

- Pre-made pinwheel for each participant or participant group
- Scissors
  Straight pins
  Pencils with erasers
  Paper (various weights - construction paper, index cards, cardboard)
  Pinwheel patterns
  Optional - paper plates, aluminum pie plates, paper clips, coffee stirrers, popsicle sticks
  - *How Can We Design a Better Pinwheel* Handout (Appendix G)
  - *Planning and Investigating a Better Pinwheel* (Appendix H)
  - *Make a Better Pinwheel: Review and Share* (Appendix I)

Trainer Notes:

STEP 1: SET CONTEXT

How many of you have played with a pinwheel on a windy day? Visited a wind farm? Thought about efficient ways that wind energy can be harnessed to do provide a source of alternative energy for your home or your community?

STEP 2: OBSERVE WINDMILL

On your table you will find pinwheels that look like familiar toys.

Set context
5 minutes
Observe pre-made pinwheels
5 minutes
Make Better Pinwheels and test them
15 minutes
Raising questions
10 minutes
Checklist and analyzing meaning
10 minutes

Show your pre-made pinwheel.
Blow on it and remind the participants how much fun it was, as a child, to run with a pinwheel and watch it turn.

In this session, you will have an opportunity to observe and explore the pinwheel, (hold up a pre-made pinwheel again) and redesign it to make it "better". You will conduct a mini-investigation through an activity where you will explore pinwheels, raise questions and work collaboratively in teams of two or three to make and test an hypothesis.

Explain that each group of 2–3 people should work with one pinwheel.

Hand out, *Planning and Investigating a Better Pinwheel.*

I would like you to take a couple of minutes to play with your pinwheel to explore how it works and to discuss what could make it work more efficiently (observation and prediction). Use the questions provided on your hand-out to assist you in your exploration. What happens when the wind blows straight into the front of the pinwheel? From either or both sides? What could make your pinwheel turn more easily? What else could be altered or improved to make it work more efficiently?

In your group answer the question: How can we make a better pinwheel?

Take a couple of minutes with your group to decide what aspect or function of your pinwheel you would like to improve and how you plan to do to redesign it to make that improvement (e.g. change number of blades to turn faster; use paper that makes it turn the smoother; place spacers between the shaft and blade to increase ease of turn). Write down or draw your plans, remembering to keep it brief. Hypothesize what you think will happen as a result of your redesign and write down your hypothesis.

STEP 3: MAKE BETTER PINWHEELS

After you have documented your hypothesis and design plans to make a "better" pinwheel, choose materials from the table and create your pinwheel. Decide how you will try out your pinwheel to observe effects, be sure to record questions that come up and observations on your worksheet: "What did you find out?" and "We think this happened because…"

After about 10 minutes, we'll share people's observations and questions. Have fun!

Circulate among participants and facilitate the making and testing of pinwheels. As you move about the room, prompt teams to think about one or two of the steps if you notice they are stuck or are obviously missing the benefit from considering the step(s). Use the following questions as prompts:

1) Have you Decided on one aspect or function you would like to improve? (variable), 2) Are you creating a Plan to determine how you would re-design the pinwheel to demonstrate improved function? 3) Have you written down a Hypothesis of what might change as a result of your re-design?, 4) Are you ready to Build your "better pinwheel"?, 5) Have you Tested your pinwheel?, 6) Have you written down Recommendations for future design options?

For the first few minutes of trials, simply give participants free exploration time to notice patterns and trends. Then you can remind them to record observations and questions, especially if you hear them verbalized. If you see expressions of confusion or wonder, you might say, "it seems you are puzzled by …"or "it seems like you have a question about…"

Prompt them to move through the construction and trials with observations as quickly as possible without being too rushed.

STEP 4: RAISING QUESTIONS

After approximately 10 minutes, ask participants to return to their seats and to organize their observations and add additional observations, including drawings. Ask participants to share a few of the things they noticed.

Connect observations to the facilitator background section on the main science ideas about pinwheels:

A pinwheel is a turbine.

A turbine changes wind energy into rotational mechanical energy.

Mechanical energy goes through a gearbox and a generator changes mechanical energy into electrical energy.

Electrical energy sent to a battery or grid stored to power a home or community.

Ask what they observed about their process and record their observations. Also ask them what science words they heard from the facilitator and each other.

Ask what questions the activity generated with participants, especially questions that people would be interested in investigating further if we had time. Give participants a couple of minutes to write at least two questions. Solicit some of their questions and post on chart paper. If you overheard some from participants, you can say—I overheard this—and give an example of a testable question.

Now we want to identify key components of 4-H Science learning activities. As you look at your handout, let's discuss what is covered in this activity and what is not and how this activity could be part of a larger curriculum.

Why do you think we started with a pinwheel that was exactly the same for everyone?

It represents and helps to define a topic of interest/content area

It establishes a "standard" pinwheel that participants can use to identify variables.

It provides participants with a common language and background about pinwheels.

What benefits came from extending the exploration into a more open-ended activity?

It provided learners and opportunity to:

- *Articulate characteristics or functions of pinwheels that could be improved*
- *Contribute creative and inventive solutions to a problem based on observation and "group think"*
- *Practice steps of scientific inquiry and the engineering design process*
- *Practice 4-H Science abilities*
- *Increase intensity and duration of the learning*
- *Ask questions and reflect on them personally and as a group*
- *Apply what they learned about pinwheels and what they predict about pinwheels in a re-design process*

What are ways you could see using this type of activity working in our own program?

***Hand out,* Make a Better Pinwheel: Review and Share.**

In the handout, we have provided you with an opportunity to reflect on the activity you just completed, thinking about it in relation to the 4-H Science Checklist. We recognize that what you have experienced is a single activity, as one example from *The Power of the Wind* curriculum. *The Power of the Wind* curriculum is a collection of activities that builds and scaffolds research-based content and targets specific outcomes. Curriculum is one key leg of our three-legged 4-H Science stool.

STEP 5: CHECKLIST AND ANALYZING MEANING

Give participants a couple of moments to review checklist. Ask them what sections of the checklist were evidenced in the activity.

STEP 6: TRANSITION

As we move forward in this workshop, notice how the next piece connects learner outcomes to previous discussions as we continue to model the intentional frameworks in 4-H Science.

What about Learner Outcomes?

Purpose:

- To identify our learner outcome and how it could be reached through the pinwheel activity.

Time:

10 minutes

Materials:

- Program Evaluation Development Tool (Appendix J)

Trainer Notes:

STEP 1: LEARNER OUTCOMES

I want you to go back to the learner outcome you had identified for that young person in your life. Take a minute and think about the pinwheel? activity we just did.

First, could this activity reach the learner outcome you had identified?

If, yes, in what ways would it help reach that learner outcome?

Two, if no, what else that could be done with this activity to reach the learner outcome? Let's say this was just one day and you got to work with this same group of children or youth on another day—what else would you need to do in order to reach your learner outcome? What other kinds of activities would you connect to this activity to strengthen your outcome?

Regardless of what your learner outcome is or how you adapt this activity or a range of activities, experiences, coaching, or dialogue to meet learner outcomes, here are a few questions to think about as you evaluate whether you have reached your learner outcomes.

STEP 2: LISTEN, LOOK AND FEEL/EXPERIENCE

Prepare ½ sheet stickies that say listen, look and feel/experience and put them next to the outcomes as you discuss them.

How do you know if success was achieved?

For each outcome, you need to identify the indicators, the signs that tell us something was learned, a behavior was changed, or a condition was improved. You can brainstorm measures by answering these basic questions.

Refer back to that list you made about the young person.

One way to think through the process of how you know things have changed to consider what you hear participants saying (listen); what you see them doing (look) and how they have changed (how they feel or what they have experienced). When you think about the first question, regarding what you would want them to know or how you want their attitude to evolve, take the opportunity to **listen**. If knowledge was gained or an attitude changed what would your hear them saying, what questions could they answer differently than before.

Think next about the behaviors you wanted them to achieve and **look**. What should you be able to observe?

And finally, think about the conditions that should potentially be altered and what should be **felt or experienced**? Are conditions (social, economic, environmental or civic) improving?

Knowing the last one is more abstract and long term, this is a very basic start to the dialogue about what measures/questions will capture the information we want to know.

Once you have identified the outcomes you are targeting and the programs you want to evaluate, ask yourself the following questions to begin to outline your evaluation plan. Handout Program Evaluation Development Tool and read through each question.

We have provided you with a way to think about evaluation—an important part of our framework. Now let's think about who is delivering the activity or your program.

Competent and Confident 4-H Science Facilitators

Purpose:

- To identify the knowledge, skills, attitudes and behaviors needed by facilitators.

Time:

50 minutes

Materials:

- Charts to be taped around the room with the 8 critical elements including the competencies and indicators
- Masking tape to put up the charts
- 4-H Science Competencies (Appendix K)
- 4-H Science Competencies Self-Assessment Tool (Appendix L)
- 4-H Science Competency Cards (Appendix M)

Trainer Notes:

STEP 1: SETTING THE CONTEXT

You have these great ideas of what young people need to know and you have these great activities to modify, create into a curriculum and then your overall program and deliver to meet those outcomes— but, the question remains- Are all your staff and volunteers ready to facilitate this work? Your answer might be—Why would we expect everyone to be ready?

Let's take some time to think about what it is going to take for our staff and volunteers.

What knowledge, skills, attitudes or behaviors are they going to have to have?

Take your learner outcome, think about the activity and come up with just one they would need.

Have people share a couple of the competencies.

STEP 2: REVIEWING THE COMPETENCIES

Refer to the handout of the competencies.

The 4-H Science Professional Development Team, made up of both external and internal expertise, has been working on just this question.

What will it take for the staff and volunteers who work with youth in order to reach learner outcomes in 4-H Science?

One framework for understanding youth development in 4-H is the eight essential elements; it provided the structure for the 4-H Science competencies. The 4-H Science competencies use this framework and identify what it would take for a staff or volunteer who leads 4-H Science activities.

Take a couple of minutes to review this document and then we are going to think about it a little deeper.

Ask for volunteers to describe something they noticed about the competencies.

Which competencies do you think it would take to facilitate the activity that we did?

STEP 3: THINKING DEEPER ABOUT THE COMPETENCIES

Now, I want you to think for a minute about these competencies in your own work. Take a look around the room and notice the 8 essential elements—one on each flip chart. I want each of you to go stand by the chart that you think is the very most critical for staff or volunteers to have in order to make sure that we reach the outcomes we want to for young people in our 4-H Science initiative.

Remember there is no right or wrong answer—this is each individual's opinion and a chance to think deeper about these competencies for 4-H Science.

Give them a couple of minutes to go stand by a chart. Ask that when they get there they talk with each other about why they chose that specific critical element.

Go to each chart where people are standing and ask a representative to explain the reasons why people stood at this specific chart.

Once you have gone through the elements and gotten their input—now ask them to go stand at the critical element that they think their staff and volunteers would need the most training and support in order to truly meet the outcomes they had identified.

Give people a chance to discuss this and then find out their reasons for this specific choice.

Thank everyone and have them sit down.

We have had a chance to think a little deeper, share our thoughts and begin to analyze why we made those decisions.

Tell me a little more about what you think about this particular set of competencies and how you might be able to use them in your own work with science, engineering and technology programs.

STEP 4: REVIEW THE SELF-ASSESSMENT AND CARDS

Hand out the self-assessment tool, explaining that this piece is being developed by the advisors as well for people to use to assess themselves and make their own plan for development. In addition, this could be used as a pre and post test for a training and the entire list of competencies might be used as the key outcomes needed for a specific training or staff development effort like coaching or mentoring or working online. The self-assessment tools breaks the competencies down into what it looks like when it is happening—the indicators.

How else might you be able to use this self-assessment tool?

Hand out the cards and explain how they could be carried in a pocket and one could be focused on at a time or a coach could use it to consider particular skills.

Competencies are another piece of our intentional framework for 4-H Science that connect to the logic model, the evaluation pieces, the programmatic structure and all connected to the 4-H Science Checklist.

Any questions about these separate pieces we have covered?

STEP 5: TRANSITION

To end this session, we would like you to have an opportunity to do an overall assessment of your own 4-H Science program—including your program, professional development and evaluation.

Closure

Purpose:

- Assess Science in their area to determine next steps.

Time:

20 minutes

Materials:

- Post-Assessment (Appendix N)

Trainer Notes:

STEP 1: REVIEW PURPOSE

Remind people that the purpose of this workshop was really to help them learn about and experience the framework that guides the 4-H Science initiative and to provide tools that they can use in their own 4-H Science program.

It is important that we consider the content and context and that we think about the different elements that lead to quality—we have framed these as evaluation; program/curriculum and professional development.

STEP 2: POST ASSESSMENT

Now take a couple of minutes and individually or, hopefully as a team, complete the post assessment tool. The purpose is to identify how these tools and framework can be used as you go back to your 4-H Science work and identify your team's priorities.

Ask for a couple of examples of what people learned from completing the post assessment and their priorities for their team.

Thank you for sharing your thoughts and the great work you are doing and your hopes for young people.

Appendix A
4-H Science Needs Pre-Assessment

Please review each of the topics below and circle the appropriate rating in terms of your ability, the topic's priority to your organization this year and priority to effectively do your job. Use the scales at the end of this assessment form.

	Ability	Priority to your organization this year	Priority of this in your position
Why 4-H Science? What is the purpose of the 4-H Science initiative?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable providing 4-H Science programs based on National Science Education Standards?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable providing children and youth opportunities to improve their 4-H Science Abilities?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable providing opportunities for youth to experience and improve in the Essential Elements of Positive Youth Development?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you trained to act as mentor, coach, facilitator and co-learner and operate from a perspective that youth are partners and resources in their own development.	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK

	Ability	Priority to your organization this year	Priority of this in your position
Are you comfortable leading activities from an experiential approach to learning?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable using inquiry to foster the natural creativity and curiosity of youth?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
How comfortable are you with your familiarity of 4-H Science outcomes?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
How comfortable are you in identifying and accessing evaluation resources for 4-H Science programs?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
How comfortable are you in developing indicators and designing evaluations for 4-H Science programs?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
How comfortable are you using the 4-H Science Checklist to influence the development and implementation of activities and larger programming efforts.	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable with your knowledge of the 4-H Science Competencies—what are they and how can they be used?	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK

	Ability	Priority to your organization this year	Priority of this in your position
Are you comfortable using the 4-H Science Competencies to assess and develop a professional development plan.	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Other (please explain)	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Other (please explain)	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK	5 4 3 2 1 0 DK

ABILITY SCALE

5 = Advance level of ability (having broad understanding and well-developed skills: able to function in complex and varied situations; be a model of subject mastery and skills).

4 = Above average ability.

3 = Average ability (having an understanding of subject matter and developed skills; able to function in a broad range of moderately difficult situations).

2 = Below average ability

1 = Beginning level of ability (probably not familiar with some key principles; not especially confident about demonstrating this activity in relatively simple situations).

0 = No experience or training in this area

DK Don't know

PRIORITY SCALE

5 = One of the highest priority skills or activities to be effective

4 = High priority

3 = Medium priority

2 = Lowest priority

0 = Not a priority

DK = Don't know

BASED ON THIS ASSESSMENT, RANK YOUR TOP 5 PRIORITIES:

1._____

2._____

3._____

4._____

5._____

Participant's Name_____

Name of University or College_____

Position_____Length of time in position_____

Briefly describe background (education, training or work experience) that prepared you for your position.

Briefly describe your major job responsibilities.

Describe, in your own words, 4-H Science.

Appendix B
4-H Alumni Bios

Brian Berchtold

Industry: Engineering
Company: US Dept of the Navy
Department: Damage Control/Fire Fighting

Bio/Story: I grew up participating in the 4-H Small Engine, Woodworking, Electrical, and Youth Council Programs in Atlantic County, NJ, culminating with a trip to National 4-H Congress in 1983 for Petroleum Power. Pariticipation in the industrial segment of 4-H stimulated a desire to seek a degree in Mechancial Engineering from Rutgers University (of which NJ 4-H was an extension of). I have worked with the Navy since receiving a BS in ME in 1989 and recently entered the Fire Protection Engineering Masters Program at University of Maryland. I continue to use the engineering fundamentals, as well as the leadership and public speaking/ communication skills attained from my 4-H participation on an everyday basis. I also represent the Navy on a number of National Fire Protection Association Technical Committees, which provides an opportunity to influence world-wide standards for fire fighter protective equipment. My 4-H leadership skills also enhanced my ability to serve as my Township's Fire Chief for the 2002-2006 time period.

Impactful Accomplishments: Lead the government effort to re-design the aircraft fire protection installations on the new generation of aircraft carriers.

Attributes Career/Current Success to 4-H: Yes

Reason: Small Engines Program (Petrolem Power)

Laura Kapa

Industry: Chemical/Biological Science
Company: Georgia Institute of Technology
Department: Biology

Bio/Story: I come from a rural town in Georgia where I was in 4-H from the 5th grade until I graduated from college. 4-H helped me to attend the University of Georgia which ultimately led me to my career now as a research scientist working on ovarian cancer.

Impactful Accomplishments: I'm currently working on a project which would enable ovarian cancer to be detected earlier thus increasing the survival rate of patients.

Attributes Career/Current Success to 4-H: Yes

Reason: Thanks to 4-H I wanted to go into the college of agriculture at UGA which provided me with opportunities for undergraduate research.

Joseph A. Huwaldt

Industry: Engineering
Company: Rocketplane Global, Inc.
Department: Engineering

Bio/Story: I am the Chief Engineer for the Rocketplane XP suborbital space plane project at Rocketplane Global, Inc. I am responsible for all the engineering analysis and sys engineering required to design and build this new space plane.

Impactful Accomplishments: I am working to bring space flight to common, everyday people, one step at a time. I am hoping that my work will help lead us towards becoming a space faring civilization.

Attributes Career/Current Success to 4-H: Yes

Reason: Rocketry.

Chris Matocha

Industry: Earth and Space Science
Company: University of Kentucky
Department: Plant and Soil Science

Bio/Story: Actively participated in 4-H for about nine years. I received a 4-H scholarship to attend Texas A&M University and eventually received a Ph.D. in soil chemistry. I currently serve as a faculty member in the Plant and Soil Science department at the University of Kentucky.

Impactful Accomplishments: Received a grant to study nitrogen fertilizer transformations. This will help farmers better utilize nitrogen and preserve the environment.

Attributes Career/Current Success to 4-H: Yes

Reason: Method demonstration dealing with soil science.

4-H Science 101:

Development, Delivery and Assessment of 4-H Science Programs

Graffiti Walk and Introductions . .10 minutes

Intentional Framework . . . . . .25 minutes

Intentional Learner Outcomes . . .30 minutes

BREAK . . . . . .10 minutes

Wind Energy . . . . . .65 minutes

What About Learner Outcomes . .20 minutes

BREAK . . . . . .10 minutes

Competent and Confident
4-H Science Facilitators . . . . . .50 minutes

Closure/Assessment . . . . . .20 minutes

Appendix D
4-H Science Checklist

A "4-H Science Ready" 4-H experience is a program that is framed in science concepts, based on Science standards and intentionally targets the development of 4-H Science abilities and the outcome articulated by the 4-H Science Logic Model. Additionally, it integrates the Essential Elements and engages participants in experiential and inquiry based learning. In addition to the following criterion below, it also recommended that 4-H Science programs offer a sustained learning experience which offers youth the opportunity to be engaged in programs with relevant frequency and duration. Utilize the following checklist to self assess the program you deliver.

To meet the needs of children, youth and the nation with high-quality science, engineering and technology programs…

Are you providing science, engineering and technology programs based on National Science Education Standards?

Science education standards are criteria to judge quality: the quality of what young people know and are able to do; the quality of the science programs that provide the opportunity for children and youth to learn science; the quality of science teaching; the quality of the sy that supports science leaders and programs; and the quality of assessment practices and policies.
http://www.nap.edu/readingroom/books/nses/

Are you providing children and youth opportunities to improve their 4-H Science Abilities?

Predict, Hypothesize, Evaluate, State a Problem, Research Problem, Test, Problem Solve Design Solutions, Measure, Collect Data, Draw/Design, Build/Construct, Use Tools, Observe, Communicate, Organize, Infer, Question, Plan Investigation, Summarize/Relate, Invent/Implement Solutions, Interpret/Analyze/Reason, Categorize/Order/Classify, Model/Graph/Use Numbers, Troubleshoot, Redesign, Optimize, Collaborate, Compare

Are you providing opportunities for youth to experience and improve in the Essential Elements of Positive Youth Development?

Do youth get a chance at mastery – addressing and overcoming life challenges in your programs?

Do youth cultivate independence and an opportunity to see oneself as an active participant in the future?

Do youth develop a sense of belonging within a positive group?

Do youth learn to share a spirit of generosity toward others?

Are learning experiences led by trained, caring adult staff and volunteers acting as mentors, coaches, facilitators and co-learners who operate from a perspective that youth as partners and resources in their own development?

Are activities led with an experiential approach to learning?

Are activities using inquiry to foster the natural creativity and curiosity of youth?

Does your program target one or more of the outcomes on the 4-H Science Logic Model and have you considered the frequency and duration necessary for youth to accomplish those outcomes?

Appendix E

Trainer Resource for 4-H Science Checklist

National Science Education Standards – Who uses either National or State Standards in your 4-H Science/work? We have found ways to include the National Science Education Standards and the broader recommendations from the National Research Council in our work. The national standards provide a consistent base of quality content on which our program design, development, delivery and, assessment is built.

4-H Science Abilities – We have identified 30 science Abilities or process skills that are practiced in the areas of science, engineering, and technology. Why or why isn't it important to choose certain ones to emphasize in your local program? How do children and youth get practice with these and other science process skills through your local program?

Youth Development – Essential Elements – How many of you call your work youth development? 4-H is committed to a Positive Youth Development approach that, again, *intentionally,* focuses on having youth walk away from their 4-H experience with a sense of belonging, increased independence, skill mastery and a spirit of generosity. Two other aspects of Positive Youth Development include youth as partners and resources with caring adults and a hands-on, creative, experiential learning approach (or fun, as we often say) with youth.

Trained adults and volunteers working with youth as partners and resources – We will talk about this a little later as time permits, but for now know that we work with about 500,000 volunteers. How we prepare them as facilitators and front-line youth workers is critical to the effectiveness of 4-H Science. Our commitment is to ensure that these people are trained, that we are clear about our expectations, and that we provide the tools to do this work.

Hands-on, experiential, inquiry, creativity, and innovation – We are familiar with experiential learning that embraces creativity and innovation, but as an initiative that focuses on 4-H Science, it is also paramount that our work with youth comes from an inquiry approach.

When I say inquiry approach, I refer to more than questions, deepened learning and processing, although all play a part. What does inquiry mean to you? What does it look like in your local program?

4-H Science Outcomes – The 4-H Science logic model articulates outcomes in the short, intermediate and long -term level that provide a national focus for the direction of our efforts. Locally, it is the intent to design programs that support these outcomes.

Appropriate Intensity, Frequency and Duration – In regards to the outcomes you are trying to achieve are you developing a true program model that allows for the appropriate intensity, frequency and duration levels to achieve desired results?

Appendix F 4-H Science Logic Model

Situation	Inputs	Activities:	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Description of challenge, problem, or opportunity: • Unsolved worldwide social problems need to be addressed by science • In the US, shortage of scientists and people understanding science • Under-representation of women and minorities in science careers • Need a diverse pool of trained scientists to frame and solve problems and educate others. • General population in the US (and world-wide) lacks basic understanding of science methods and content ("science literacy")	***What we invest:*** • Federal, state and private funds • 4-H Infrastructure • Land Grant Univ. Support • County Extension administrators and agents, program coordinators, and specialists • Training • Knowledge • Collaborations with external researchers • Collaborations with science industry leaders	***What we do:*** • Select and develop 4-H Science curricula • Select and train volunteers • Market 4-H Science to increase interest participation • Conduct non-formal education (learning and teaching, facilitated inquiry and discovery) • Facilitate question formation and problem solving through guided activities • Provide or supplement math programming • Teach youth about academic and career choices, requirement *Who we reach* (Participation): • Extension administrators, LGU and Extension faculty and staff) • Youth (grades 3–5, 6–8, 9–12) • Federal, state & private funders • Partners • Public	***What we produce:*** • 4-H Science curricula • New instructional methods • Trained staff and volunteers • Adult participants engaged • Youth participants engaged • Partners (Other federal agencies, science museums, youth organizations, etc.) collaborating • Marketing materials • Evaluation materials	***Occurs when there is a change in knowledge or the participants learn:*** • Increased awareness of science among youth • Improved science skills (scientific methods) and knowledge (content areas) among youth • Increased awareness of opportunities to contribute to society using science skills. • Increased life skills	***Occur when there is a change in behavior or the participants act upon what they've learned and:*** • Youth apply science learning to contexts outside 4-H (e.g., school classes, science fairs, invention contests, etc.) • Youth adopt and use new methods or improved technology • Youth demonstrate use of life skills • Youth express interest/ demonstrate aspirations towards science careers (career fairs, job shadowing, volunteer work or internships) • Youth raise questions and identify problems to be addressed using science	***Occur when a societal condition is improved due to a participant's action taken in the previous column.*** • Increased number and more diverse pool of youth pursuing education and careers in science-related fields. • Increased and more diverse pool of trained teachers, educators, scientists • Increased science literacy in general population • Increased innovation addressing social problems using science

ASSUMPTIONS – 4-H non-formal experientially-based programming addresses science abilities. concepts and content under guidance of trained (scientifically able) 4-H learning facilitator; 4-H develops appropriate science abilities to emphasize in non-formal education; 4-H essential elements create optimal youth development context for learning; 4-H reaches diverse population; and increased awareness of science skills, content, and career possibilities increases engagement of youth in science

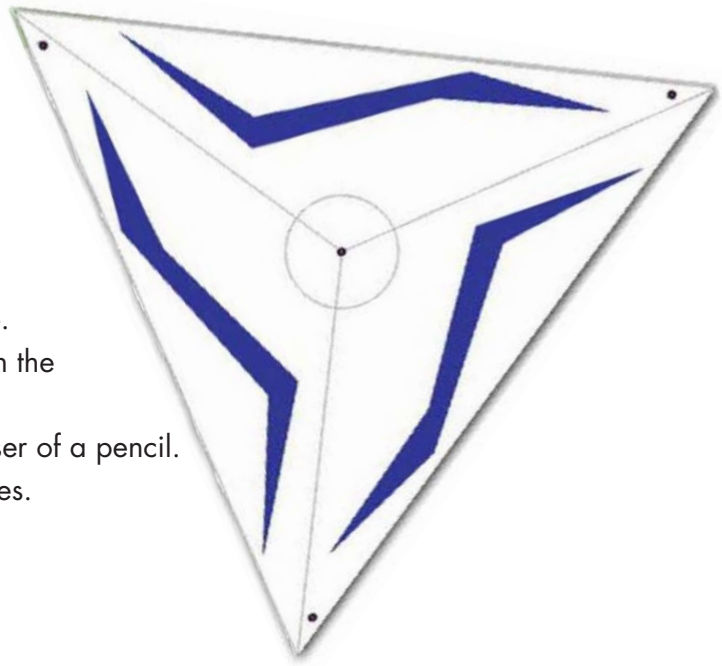
EXTERNAL FACTORS – Youth experience in schools including [with] science & mathematics, No Child Left Behind (course content, testing, tutoring provided in school), changing landscape of schools, community and family influence (e.g., religious teaching on Creationism), population changes, immigration, global economy and competition in science education and science pursuits.

Note: 4-H Science encompasses science, engineering, technology, and applied math.

NOVEMBER 1, 2010

Appendix G

How Can We Design a Better Pinwheel?[1]



Try It

- Cut out the triangular pinwheel in Appendix C.
- Make a design on the pinwheel that has rotational symmetry.
- Cut on the lines from the corners to the center circle.
- Curl the dots at the corners to line up with the dot in the center circle.
- Push the pin through all three dots and into the eraser of a pencil.
- Design and build another pinwheel with more blades. Start with a hexagon, octagon or other polygon.

You Will Need:

- Scissors
- Straight pins
- Pencils with erasers
- Paper (various weights—construction paper, index cards, cardboard)
- Pinwheel patterns from Appendix C

Other Possible Materials:

- Paper plates
- Aluminum pie plates
- Paper clips
- Coffee stirrer
- Popsicle sticks
- Miscellaneous hardware and office supplies

[1] Sebestik, J (2008). *The Power of the Wind Youth Guide*. University of Illinois

In Your Engineering Notebook

Write or sketch answers to questions you find important or interesting.

Make several pinwheel variations.
What other aspects of the design change the way the pinwheel works?

How well do other pinwheel shapes work?

Vary the number, shape, and size of the blades.

What materials work best? Is stiffer paper too heavy?

Record your observations about the various designs in your engineering notebook.

Make sketches or include photos.

Talk About It

- How did your group define "best?"
- Why is it important to change only one thing or variable at a time?
- Which pinwheel designs turn faster using wind energy? How do you know?

Learning from Others

- Which pinwheel designs does the entire group think are the best? What does your entire group mean by "best?"
- What other changes could you make to the design that might change the speed?
- Why might speed be important in working windmills and wind turbines?
- What do you observe about the blades of working windmills and wind turbines? Think about their shape, length, and speed.

Wind Facts

- Normal breathing causes a 5 mph "wind."
- Sneezes can travel at a speed of 100 mph.
- The ancient Greeks thought wind was the breath of the earth.

Appendix H

Planning and Investigating a Better Pinwheel

Planning a Better Pinwheel

What happens when the wind blows straight into the front of the pinwheel?

What happens when the wind blows from either or both sides?

What could be altered or improved to make the pinwheel turn faster? Turn slower? Turn more easily? Work more efficiently?

What one change do we want to make on our pinwheel?

Investigating a Better Pinwheel

What is our hypothesis? What do we predict will happen as a result of our redesign?

What are our design plans (write or draw) to make a better pinwheel?

What did we notice/observe about the trials?

What questions come to mind?

Appendix I

Make a Better Pinwheel: Review and Share

Criteria	Yes	No	Comments
National Science Standards			
Opportunity to practice science, engineering and technology abilities			
Opportunity to improve essential elements of positive youth development			
Evidence that learning experience is led by trained, caring adults as mentors, coaches, facilitators, and co-learners			
Experiential approach to learning			
Inquiry approach to learning			
Target outcomes of the 4-H Science Logic Model			

How does this activity helps to build and anchor the content in *The Power of the Wind Curriculum* and the Engineering Design Process?

Appendix J

Program Evaluation Development Worksheet

Intended Outcome: _____

Target Program(s):_____

Once you have identified the outcomes you are targeting and the programs you want to evaluate, ask yourself the following questions to begin to outline your evaluation plan.

Who is the audience?

After participation, what will they know?

After participation, what will they do?

What will "doing" look like?

Who is in a position to see it?

When can we ask them?

How can we ask them?

Appendix K

4-H Science Core Competencies

The 4-H Science core competencies identify how 4-H youth development workers can be competent and caring resources to youth, organizations, and communities. 4-H youth development professionals and volunteers implement 4-H Science programs that offer the following eight essential elements.

CARING ADULT

UNDERSTANDS THAT EACH YOUNG PERSON BENEFITS FROM A POSITIVE RELATIONSHIP WITH A CARING ADULT BY:

1. Communicating the capacity of all youth to learn and experience success.
2. Willing to learn alongside youth.
3. Being comfortable not having all the answers.
4. Demonstrating support for all youth, regardless of their challenges.
5. Understanding and caring about youth and their families.
6. Appreciating the context in which youth and families live.

SAFE ENVIRONMENT

CREATES AN EMOTIONALLY AND PHYSICALLY SAFE LEARNING ENVIRONMENT BY:

1. Modeling strategies for conflict resolution.
2. Encouraging youth to share new ideas and different perspectives.
3. Modeling and facilitating how to give and receive constructive criticism.

4-H Science Core Competencies

INCLUSIVE ENVIRONMENT (BELONGING)

DESIGNS INCLUSIVE LEARNING ENVIRONMENTS BY:

1. Promoting teamwork and cooperation.
2. Providing opportunities for youth to teach and learn from each other.
3. Demonstrating respect for others.
4. Fostering an environment of mutual respect for others.

SEE ONESELF IN THE FUTURE (SENSE OF HOPE)

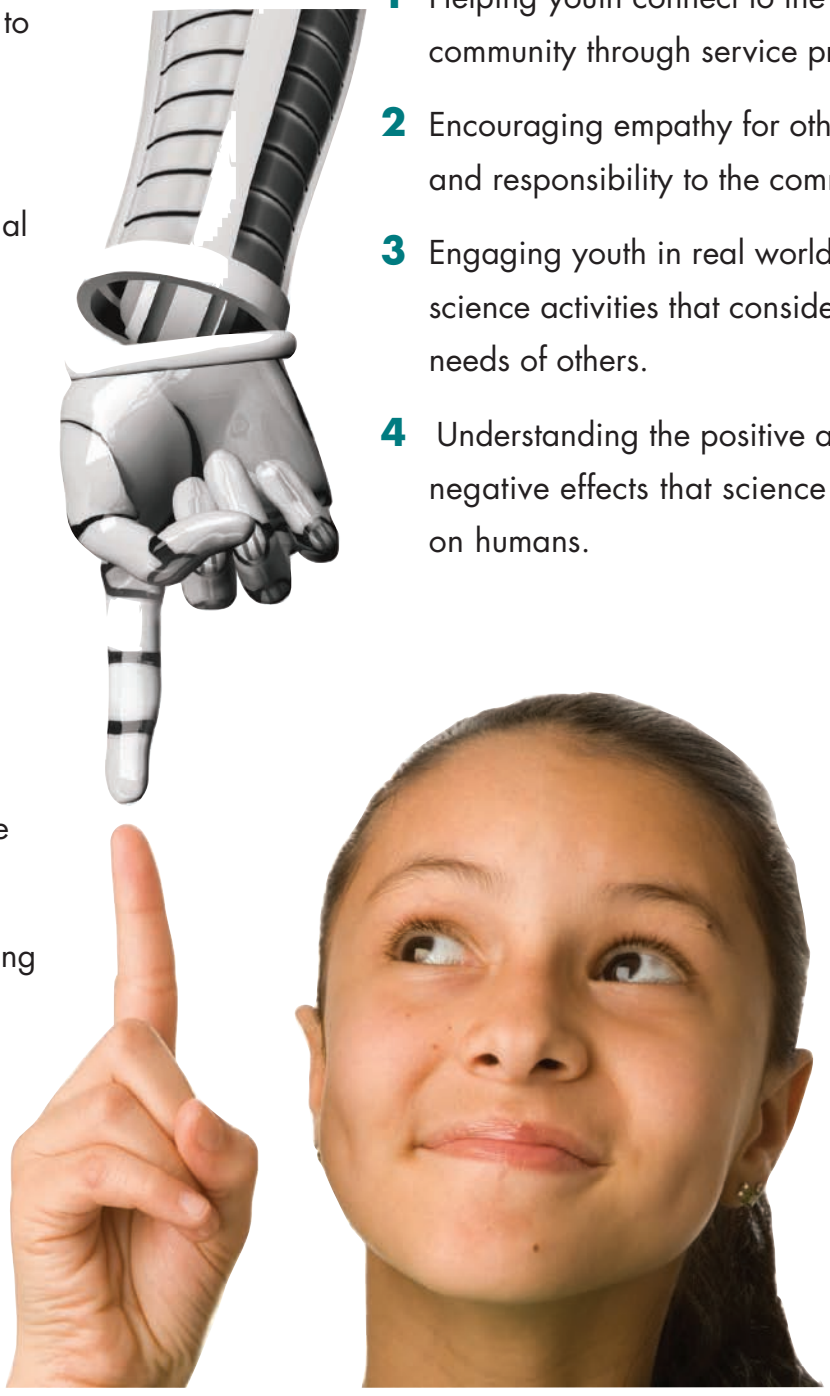
NURTURES AN ATMOSPHERE OF OPTIMISM AND A POSITIVE BELIEF IN THE FUTURE BY:

1. Encouraging the belief that all youth can learn science or pursue science careers.
2. Creating a science-friendly learning environment.
3. Promoting science careers for all youth, regardless of their gender, race, or ethnicity.
4. Demonstrating how science can improve the world.

VALUES AND PRACTICES SERVICE TO OTHERS

ENCOURAGES AN ETHIC OF CARING AND CIVIC RESPONSIBILITY BY:

1. Helping youth connect to the community through service projects.
2. Encouraging empathy for others and responsibility to the community.
3. Engaging youth in real world science activities that consider the needs of others.
4. Understanding the positive and negative effects that science has on humans.



4-H Science Core Competencies

OPPORTUNITIES FOR SELF-DETERMINATION

ENCOURAGES AND SUPPORTS INDEPENDENCE IN YOUTH BY:

1. Helping youth set their own goals.
2. Encouraging youth to make their own decisions.
3. Describing pathways to engage in science careers.
4. Communicating the value of science for all.

OPPORTUNITIES FOR MASTERY

PROVIDES OPPORTUNITIES FOR YOUTH TO DEVELOP SKILLS, COMPETENCE, AND EXPERTISE BY:

1. Designing experiential, inquiry-based, opportunities for youth to learn 4-H Science skills.
2. Challenging youth to explore new or different 4-H Science projects and areas of learning.
3. Supporting youth in achieving their goals in the face of setbacks.
4. Knowing how to foster an increasing development of skills in youth.

ENGAGEMENT IN LEARNING

ENCOURAGES YOUTH TO DIRECT AND MANAGE THEIR OWN LEARNING BY:

1. Assisting youth in setting realistic goals of their own choice.
2. Encouraging an inquiry approach to learning and exploration.
3. Providing sufficient time and an appropriate environment for thorough learning.

Appendix L

4-H Science Competencies Self Assessment Tool

The self-assessment tool can be used by volunteers and staff — facilitators, peers, mentors, and coaches — to provide examples of what 4-H Science competencies look like to assess the level to which a 4-H Science facilitator has developed the competencies needed to effectively implement 4-H Science. It can also be used as a training outline to assist trainers in determining the components needed in a 4-H Science training. Assessment tools are designed to be coaching tools, not performance reviews, so that individual facilitator's competencies can be gauged and plans made to ensure progress toward knowledge and skills development.

Adapt, adapt, adapt...this tool is flexible. Use all or parts of this tool when relevant to your work. Some 4-H providers may choose to shorten this tool to make it more practical for a quick assessment for a short-term employee (also see short observation cards). You may decide to identify 3 - 4 areas that you want to strengthen the most.

4-H Science Competency Self Assessment

Please fill in the circle that tells how much you currently are capable of using the knowledge and skills in these of these areas when you work with youth in 4-H Science programs.

	0 Never	1 Sometimes	2 Usually	3 Most of the Time	4 Always
CARING ADULT					
I use language of respect	○	○	○	○	○
I listen to youth in a non-judgmental way	○	○	○	○	○
I demonstrate shared leadership though youth-adult partnerships	○	○	○	○	○
I encourage youth to think about what they are learning	○	○	○	○	○
I make verbal contact with all youth	○	○	○	○	○
I encourage learners when they experience setbacks	○	○	○	○	○
I offer praise and encouragement when youth take initiative and leadership	○	○	○	○	○
I identify, build on, and celebrate the potential of all youth	○	○	○	○	○
I respect youth of different talents, abilities, sexual orientations, and faiths.	○	○	○	○	○
INCLUSIVE ENVIRONMENT (BELONGING)					
I help youth feel welcome and part of a group	○	○	○	○	○
I establish a climate of fairness and openness	○	○	○	○	○
I respond positively to the ranges of youth's feelings	○	○	○	○	○
I cultivate a sense of togetherness among youth	○	○	○	○	○
I value and act upon the ideas of others	○	○	○	○	○
I serve as a role model for inclusion and tolerance	○	○	○	○	○
I initiate, sustain, and nurture group interactions and relationships.	○	○	○	○	○

	0 Never	1 Sometimes	2 Usually	3 Most of the Time	4 Always
SAFE ENVIRONMENT					
I conduct myself in a calm manner	○	○	○	○	○
I reduce or eliminate physical and environmental hazards	○	○	○	○	○
I re-emphasize ground rules related to conduct	○	○	○	○	○
I intervene when safety demands it	○	○	○	○	○
SEE ONESELF IN THE FUTURE (SENSE OF HOPE)					
I project an optimistic, positive manner	○	○	○	○	○
I reinforce the idea that all youth can succeed	○	○	○	○	○
I offer positive encouragement and support even in the face of setbacks	○	○	○	○	○
I talk about the future and youth's role in it	○	○	○	○	○
VALUES AND PRACTICES SERVICE TO OTHERS					
I encourage youth to contribute to the communities in which they live	○	○	○	○	○
I voice support for giving back to the community through service	○	○	○	○	○
I believe in science's role in improving communities	○	○	○	○	○
I provide opportunities for youth to link their experiences to citizenship	○	○	○	○	○
I identify opportunities for youth to become civically engaged	○	○	○	○	○
OPPORTUNITIES FOR SELF-DETERMINATION					
I provide experiences that encourage youth to share evidence	○	○	○	○	○
I identify opportunities for youth to compare claims with each other	○	○	○	○	○
I articulate strategies for data collection and analysis	○	○	○	○	○
I work with youth to identify sources of information	○	○	○	○	○
I actively consult, involve, and encourage youth to contribute to others.	○	○	○	○	○
I provide opportunities for youth to determine program expectations and direction	○	○	○	○	○

	0 Never	1 Sometimes	2 Usually	3 Most of the Time	4 Always
ENGAGEMENT IN LEARNING	○	○	○	○	○
I guide youth in learning for themselves	○	○	○	○	○
I create opportunities for problem-solving via discussion, debate, and negotiation	○	○	○	○	○
I worth with youth to establish appropriate goals for their age	○	○	○	○	○
I provide opportunities for youth to link their experiences to the real world	○	○	○	○	○
I use a variety of questioning and motivational approaches	○	○	○	○	○
I use multiple learning approaches to meet learner's needs	○	○	○	○	○
OPPORTUNITIES FOR MASTERY					
I suggest challenges that can be explored by direct investigation	○	○	○	○	○
I encourage youth to make predictions	○	○	○	○	○
I assist youth in developing hypotheses related to their investigations	○	○	○	○	○
I allow youth to conduct formal and open-ended tests and experiments	○	○	○	○	○
I have youth discuss their findings with each other and evaluate evidence critically	○	○	○	○	○
I encourage youth to share their knowledge by teaching others and leading new activities	○	○	○	○	○
I help youth see setbacks as opportunities for new explorations	○	○	○	○	○
I support youth to set new goals, and try new ideas and approaches	○	○	○	○	○
I provide opportunity for youth to use appropriate technology	○	○	○	○	○

Appendix M

4-H Science Competency Cards

4-H Science Core Competency

CARING ADULT

1. I use language of respect
2. I demonstrate shared leadership though youth-adult partnerships
3. I encourage youth to think about what they are learning
4. I encourage learners when they experience setbacks
5. I offer praise and encouragement when youth take initiative and leadership

4-H Science Core Competency

INCLUSIVE ENVIRONMENT (Belonging)

1. I help youth feel welcome and part of a group
2. I establish a climate of fairness and openness
3. I cultivate a sense of togetherness among youth
4. I serve as a role model for inclusion and tolerance
5. I initiate, sustain, and nurture group interactions and relationships

4-H Science Core Competency

SAFE ENVIRONMENT

1. I conduct myself in a calm manner
2. I reduce or eliminate physical and environmental hazards
3. I re-emphasize ground rules related to conduct
4. I intervene when safety demands it

4-H Science Core Competency

SEE ONESELF IN THE FUTURE (Sense of Hope)

1. I project an optimistic, positive manner
2. I reinforce the idea that all youth can succeed
3. I offer positive encouragement and support even in the face of setbacks
4. I talk about the future and youth's role in it

4-H Science Core Competency

VALUES AND PRACTICES SERVICE TO OTHERS

1. I encourage youth to contribute to the communities in which they live
2. I voice support for giving back to the community through service
3. I believe in science's role in improving communities
4. I provide opportunities for youth to link their experiences to citizenship
5. I identify opportunities for youth to become civically engaged

4-H Science Core Competency

OPPORTUNITIES FOR SELF-DETERMINATION

1. I provide experiences that encourage youth to share evidence
2. I identify opportunities for youth to compare claims with each other
3. I articulate strategies for data collection and analysis
4. I work with youth to identify sources of information
5. I provide opportunities for youth to determine program expectations and direction

4-H Science Core Competency

ENGAGEMENT IN LEARNING

1. I create opportunities for problem-solving via discussion, debate, and negotiation
2. I work with youth to establish appropriate goals for their age
3. I provide opportunities for youth to link their experiences to the real world
4. I use a variety of questioning and motivational approaches
5. I use multiple learning approaches to meet learner's needs

4-H Science Core Competency

OPPORTUNITIES FOR MASTERY

1. I suggest challenges that can be explored by direct investigation
2. I encourage youth to make predictions
3. I allow youth to conduct formal and open-ended tests and experiments
4. I have youth discuss their findings with each other and evaluate evidence critically
5. I encourage youth to share their knowledge by teaching others and leading new activities
6. I provide opportunity for youth to use appropriate technology

Appendix N

4-H Science Team Post Assessment

Please review each of the topics below and circle the appropriate rating in terms of your TEAM's knowledge and ability to implement the topic. Then, list potential next steps your team will need to take to become proficient in each area. Also, for each area rank the topic's priority as it relates to your position and to your organization this year. Finally, list the top five priority steps your team needs to take in the next year. Use the scales on page one of this assessment form.

	Team knowledge & ability	Next steps to becoming more proficient in this area	Priority to your organization this year	Priority of this in your position
Why 4-H Science? What is the purpose of the 4-H Science initiative?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable providing 4-H Science programs based on National Science Education Standards?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable providing children and youth opportunities to improve their 4-H Science Abilities?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable providing opportunities for youth to experience and improve in the Essential Elements of Positive Youth Development?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK

	Team knowledge & ability	Next steps to becoming more proficient in this area	Priority to your organization this year	Priority of this in your position
Are you trained to act as mentor, coach, facilitator and co-learner and operate from a perspective that youth are partners and resources in their own development.	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable leading activities from an experiential approach to learning?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable using inquiry to foster the natural creativity and curiosity of youth?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
How comfortable are you with your familiarity of 4-H Science outcomes?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
How comfortable are you in identifying and accessing evaluation resources for 4-H Science programs?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
How comfortable are you in developing indicators and designing evaluations for 4-H Science programs?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK

	Team knowledge & ability	Next steps to becoming more proficient in this area	Priority to your organization this year	Priority of this in your position
How comfortable are you using the 4-H Science Checklist to influence the development and implementation of activities and larger programming efforts.	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable with your knowledge of the 4-H Science Competencies – what are they and how can they be used?	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Are you comfortable using the 4-H Science Competencies to assess and develop a professional development plan.	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Other (please explain)	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK
Other (please explain)	5 4 3 2 1 0 DK		5 4 3 2 1 0 DK	5 4 3 2 1 0 DK

Based on this assessment, list your team's top 5 priorities to becoming more proficient in 4-H Science implementation:

1.

2.

3.

4.

5.

References

American Association for the Advancement of Science (1993). "The Nature of Science." *Benchmarks for Science Literacy – Chapter 1.* New York. Oxford University Press.

The American Heritage Stedman's Medical Dictionary (2002). Boston: Houghton Mifflin.

Astroth, K. A. (1996). Leadership in Nonformal Youth Groups: Does style affect youth outcomes? Journal of Extension, 34(6). Retrieved from http://www.joe.org/joe/1996december/rb2.html

Broad, M.L. (2005). Beyond Transfer of Training: Engaging Systems to Improve Performance. San Francisco: Pfiefer.

Coates, D. (2007). *Enhance The Transfer of Training: Info-Line.* No. 0710.

CSREES. (2001). *National 4-H Impact Assessment Project.* Washington, D.C.: Author. Retrieved from http://www.national4_hheadquarters.gov/impact.htm

Eccles, J. S., & Gootman, J. A. (Eds.) (2002). *Community programs to promote youth development.* Washington, D.C.: National Academy Press.

Gambone, M. A., & Arbreton, A. J. A. (1997). *Safe havens: The contributions of youth organizations to healthy adolescent development.* Philadelphia: Public/Private Ventures.

Harlen, Wynne (2002). *The Teaching of Science in Primary Schools.* 3rd ed. London: David Fulton Publishers.

Horton, R.L., Gogolski, J., & Warkentien, C. (2006). Science, Engineering, and Technology (SET) Programming in the Context of 4-H Youth Development. Ohio State University Extension, The Ohio State University, Columbus, OH.

Kress, C.A. (2006) Approaches to 4-H Youth Development. National 4-H Headquarters, Cooperative State Research Education and Extension Service, United States Department of Agriculture. Washington, D.C.

Massachusetts Department of Education (2006). *Massachusetts Science and Technology/Engineering Curriculum Framework.*

National Commission on Service Learning. (2002). *Learning in deed.* Retrieved from http://www.servicelearningcommission.org

National 4-H Council. (2008). Science, engineering and technology criteria checklist. Retrieved January 2, 2009 from http://www.fourhcouncil.edu/

National Research Council (1996). "Science Content Standard." Chapter 6 in *National Science Education Standards*. Washington, D.C.: National Academy Press.

Ostlund, Karen (June 1998). "What the Research Says About Science Process Skills." Electronic Journal of Science Education vol. 2, no. 4. http://unr.edu/homepage/jcannon/ejse/ostlund.html

Padilla, M. J. (1990). "The Science Process Skills." *Research Matters – to the Science Teacher no 9004.* http://www.educ.sfu.ca/narstsite/publications/research/skills.htm

Pfieffer, J.W. & Jones, J.E. (1983). "Reference Guide to Handbooks and Annuals" John Wiley and Sons, Inc.

The Power of the Wind website http://www.4-H.org/curriculum/wind/

Scales, P. C. & Leffert, N. (1999). *Developmental assets: A synthesis of the scientific research on adolescent development.* Minneapolis: Search Institute.

Sebestik, J. (2008). *The Power of the Wind Facilitator's Guide*. University of Illinois.

Sebestik, J. (2008). *The Power of the Wind Youth Guide*. University of Illinois.

Silliman, B. (2007) Critical Indicators of Youth Development Outcomes for 4-H National Mission Mandates. North Carolina State University. Raleigh, NC.

Sneider, C. I., & Brenninkmeyer, J. (2007). "Achieving Technological Literacy at the Secondary Level: A Case Study from Massachusetts," Professional Development for Engineering and Technology.

Walker, J., & White, L. (1998). Caring adults support the healthy development of youth. The Center, 14-19. [Electronic version]. Retrieved from the University of Minnesota's Center for 4-H Youth Development website: http://www.fourh.umn.edu/educators/research/center/Center1998.html

4-H Pledge

I Pledge my **Head**
to clearer thinking,

my **Heart** to greater loyalty,

my **Hands** to larger
service,

and my **Health** to
better living,

for my club, my community, my country, and my world.