New Haven Public Schools

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OUTLINE OF PROFESSIONAL DEVELOPMENT DAY SCIENCE
Assessing Experiments SEP 18th
(revised)

8:00 – 8:15 Welcome, Orientation, Breakfast

8:30 – 9:45
Intro/Direction
-Fill out teacher info form
Auditorium
Whole Group, Table discussion: What makes a good experiment, designing experiments,
common vocabulary
math/science connection.

10:00 – 12:00 Break out by grade. Practice embedded task/lab:
seventh grade: matter (staying afloat) A305
eighth grade: bridges A301
ninth grade: plastics A308
tenth grade: enzymes A304
eleventh + grade: matter (cold packs) A307

12:00-1:00 lunch

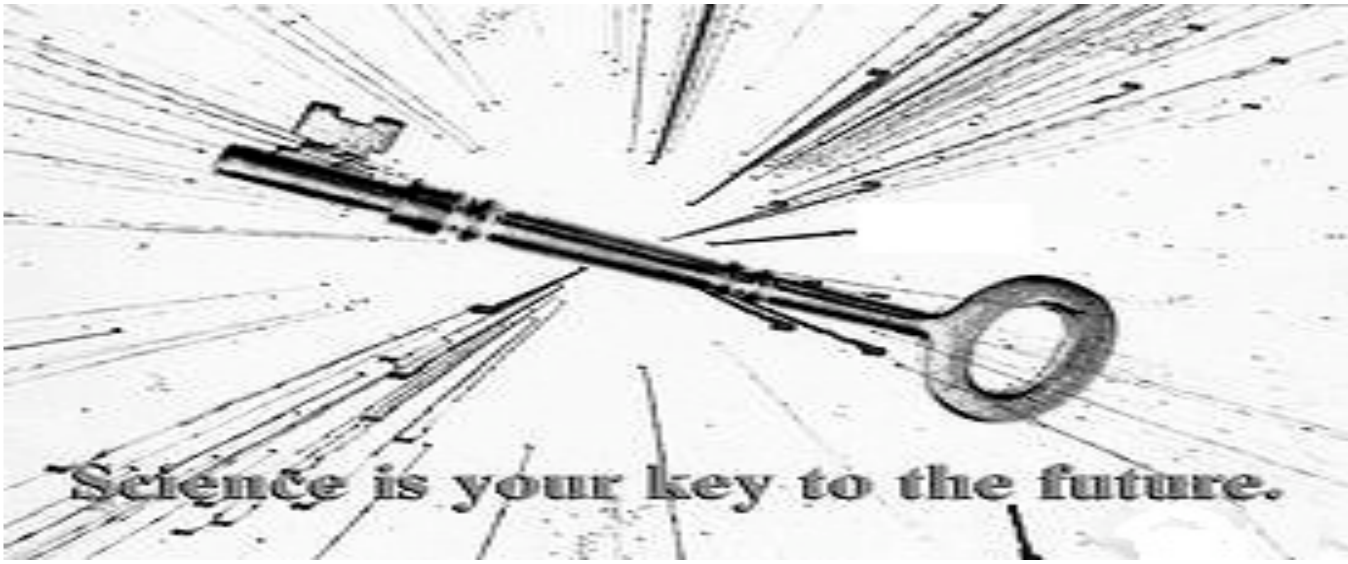
1:00- 2:20 break out groups, design/examine assessment questions, discussion on scaffolding to teach skills needed for assessment. Examination of holistic rubric.

2:35-3:00 group share, draft of initial quarterly assessment.

Attachments:
- **Teacher Info Form (Turn IN)**
- **Open Ended Experimentation Notes**
- **Draft New Haven Science Standards**
- **Workshop Evaluation (Turn IN)**
- **Science Professional Development Draft Schedule**
- **Lab Report Rubric Scoring**
- **Open Ended Questions Scoring**
- **Grade Level Tasks, Scoring, Example Assessments**
- **OTHER**

NEW HAVEN SCIENCE!

WHY TEACH SCIENCE?



RICHARD THERRIEN

K-12 SCIENCE SUPERVISOR

-DRAFT NEW HAVEN SCIENCE STANDARDS AND PACING GUIDE

-QUARTERLY ASSESSMENTS BASED ON EMBEDDED TASKS

TODAY'S GOAL:

Using science embedded tasks, teachers will
-examine learning goals for experiments.
-review common vocabulary and methods
-conduct instruction in hands-on embedded task experiments
-design embedded task follow-up assessments
-be able to use holistic rubrics to score student work on embedded task follow ups.

Core Scientific Inquiry, Literacy and Numeracy *How is scientific knowledge created and communicated?*	
POWER CONTENT STANDARDS	EXPECTED PERFORMANCES
SCIENTIFIC INQUIRY - Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena. - Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation. - Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists. **SCIENTIFIC LITERACY** - Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science. - Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media. **SCIENTIFIC NUMERACY** - Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.	**INQ1.** Identify questions that can be answered through scientific investigation. **INQ2.** Read, interpret and examine the credibility and validity of scientific claims in different sources of information. **INQ3.** Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment. **INQ4.** Design and conduct appropriate types of scientific investigations to answer different questions. **INQ5.** Identify independent and dependent variables, including those that are kept constant and those used as controls. **INQ6.** Use appropriate tools and techniques to make observations and gather data. **INQ7.** Assess the reliability of the data that was generated in the investigation. **INQ8.** Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms. **INQ9.** Articulate conclusions and explanations based on the results of the research, and assess their validity based on the design of the investigation. **INQ10.** Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

FEEDBACK AND DISCUSSION

ACTIVITY 2: EXPERIMENTAL DESIGN

What makes a good experiment?

What are the parts to a good experiment?

What is the scientific method?

PROPOSAL: Consistent approach to terminology to designing good experiments.

SCIENTIFIC METHOD: No one "right" number of steps!

Includes the idea of

finding out something to investigate (the "problem"),

coming up with a theory or hypothesis based on observations: how one property (chemical, physical, environmental, biological) affects another.

designing a good experiment to test the idea, and making a prediction.

conducting the experiment.

organizing and analyzing the results.

drawing a conclusion and stating the validity.

OBSERVE, ORGANIZE, CONCLUDE (repeat)!

HYPOTHESIS:

One property affects another property

(factor, stimuli, characteristic, measurement, observation, etc..), both can be observed/measured.

CAUSE	and	EFFECT
Independent Variable	and	Dependent Variable
"Control"		*"Responding"*
"Manipulated"		*Measured Result*
Input		*Output*

All other properties remain the same, they are "controlled".

A "VALID" experiment is one that assures that the result output (dependent variable) is due to the input (independent variable), not to any other factor.

It also has a starting point to compare to, the "control"

An **experiment** is a controlled procedure designed to test a hypothesis. There are several parts to any good scientific experiment.

HYPOTHESIS: The educated guess, or conclude part of observe, organize, and conclude. Usually it is stated as how one physical property affects another physical property. *Example: I think that*

the amount of light causes plant growth. (Light affects height)

PREDICTION: This is what you think is going to happen in your particular experiment, based on the hypothesis. A hypothesis can usually be tested in many ways, so it is important to predict for your specific experiment. A prediction usually indicates how you are going to MEASURE each of the properties

Example: I think that a plant growing in dark will be shorter than one in the light.

INDEPENDENT VARIABLE: This is the factor, or variable that you change. This is the physical property that you have direct control over to change. It should be the ONLY difference between the two groups for it to be a good experiment. It is the CAUSE property mentioned in the hypothesis.

Example: the amount of light.

DEPENDENT VARIABLE: This is the factor, or property that you measure for, or the result. It could be different between the groups, or it could be the same. You don't know the value of this variable until the end of the experiment. This is the EFFECT property mentioned in the hypothesis.

Example: how high the plant grows

CONTROL: All other variables should be the SAME in all groups, or they should be CONTROLLED.

A CONTROL GROUP is the group that is used as the basis for comparison. It could be: the BEFORE part of a before and after experiment (mixing two chemicals to see a color change, the control group is the setup before they were mixed). It could be: the "normal", or it could be the group in which the value of the independent variable is zero.

EXPERIMENTAL GROUP(S): The experimental group differs from the control group in just ONE factor or variable. This is the group that is usually mentioned in the prediction. It can also be the "after" part of a before and after experiment. It is the actual physical set of objects that you have changed or are doing something to.

Example: a plant set in a room with only a small light bulb.

CONCLUSION: after organizing the results of the observations made in the experiment, you check to see whether you are right by stating whether your predictions came true, and what you found out about the hypothesis

A good experiment, besides having careful observations, and using instruments, will always have a control group to compare to, even though it is not always clear which is the control or "normal" group, and which is the experimental group. But it is also very important to have groups in which only ONE property or variable is changed at a time, so that you can be sure that the property is the cause of whatever effect you are measuring.

OPEN ENDED ACTIVITIES (CAPT), ask students to design good experiments, with a cause and effect. (or to determine which cause has the greatest effect, and what the trend there is).

YOUR TASK:

USING THE EXAMPLES AS A STARTING POINT DISCUSS IN GROUPS:

How do you introduce the important points of experimental design in your science class?

What are some good ways to teach the scientific method and parts of good experiments throughout the year?

What other resources are needed or steps should the system take to help infuse this common theme throughout the science curriculum?

OPEN ENDED LAB ACTIVITIES

Open ended lab activities allow students to test a variety of variables to solve a problem in an open ended manner.

Most lab activities can be modified to provide students with an open needed lab experience. An open ended lab activity can be used as both a teaching and assessment tool. In all cases, students are asked to design an experiment before actually doing the activity. Students can be given choice on materials, the independent variable, and even the dependent variable. Testing how one factor affects another should be done in as realistic and authentic a manner as possible, and also lends itself to collecting good quantitative data. In all cases, paper pencil test items can also be designed to go with the activities.

Teachers can lead students up to these activities.

Example (Closed to Open)

Test how three different lengths of string affect the period of a pendulum using these materials and this procedure.

Design an experiment to test how the length of a string affects the period of a pendulum using these materials.

Design an experiment to test how either length, mass, or angle of a string affects the period of a pendulum using these materials or others you ask for.

Design an experiment to test how length, mass, and angle of a string affect the period and the slowing down of a pendulum using any materials.

Design an experiment to see what things change how a pendulum swings.

-Following are several ideas for open ended activities.

A complete lab activity with an example format, lab report scoring rubric, an open ended questions is also included.

OPEN ENDED LAB ACTIVITIES (examples)

What factors:

- about materials (sand, potting soil, limestone) or combination change the acidity and percolation rate of acid rainfall?
- about materials (type, amount, covering) best insulate a cup of water?
- about rock salt (type, amount, surface area) causes ice to melt? (speed, amount)
- about water (amount, temperature, salinity) change how plant cells respond?
- change the metabolism of a frog?
- (mass, angle of ramp, shape, lubrication, etc...) change how (speed, distance after, straightness) toy cars go down ramps?
- (color, filters, distance, angle, power) change the brightness of a light?
- change the temperature in the classroom?
- (temperature, amount, bubbles, purity) change how fast water freezes?
- (angle, mass, shape, material, color) change how (speed, distance, path) a sphere is thrown?
- (shape, bottom, materials, purity of water,) change how (speed, turbulence) a river/stream flows?
- (surface area, density, composition) affect the water retention (speed, amount in soil?
- cause a human's pulse rate to change?
- (light, temperature, food) cause a meal worm to change?
- (concentration, temperature) cause a yeast/peroxide reaction to change (rate, amount of bubbles)?
- (air pressure, amount of water, shape of bottle) cause a bottle rocket to change its flight? (speed, height, distance, path)
- (angle, distance, time) cause a light on a surface to change (brightness, temperature)
- about water (temperature, oxygen) affect the movement of fish?
- (mass, height, angle, composition) affects the (depth, width, shape) of craters?
- (concentration, catalyst, surface area, temperature) affects reaction rates?
- about populations (density, competition, food supply) affects growth?
- about air (purity, volume, flow) affects respiration rates?
- about salts (type, concentration, temperature) affects solubility?
- about an environment (temperature, barometric pressure, humidity, light, wind speed) affects some other factor?
- about a planet (rotation rate, inclination angle, distance, eccentricity) affects the seasons (temperature, duration, severity)?
- about a magnet (strength, composition, distance) affects its magnetic field?
- about a person (gender, height, weight, genes) affects some other factor?
- about an object (composition, volume, shape, height) affects its resonant frequency?
- about water (composition, salinity, movement) affects how things float the ocean?
- about the room (air, light, sound volume, temperature, light color, radiation) affects how a plant grows (height, color, cell structure)

Brief Description of Experiment:

Materials Used:

Hypothesis:

Prediction:

Independent variable(s):

Dependent variable:

Control Group:

Experimental Group(s):

Conclusion Paragraph:

Drawing of Experiment:

DATA TABLE:

ACTIVITY 3:
The Math/Science Connection

Independent Variable

Dependent Variable

Both can be a measured property.

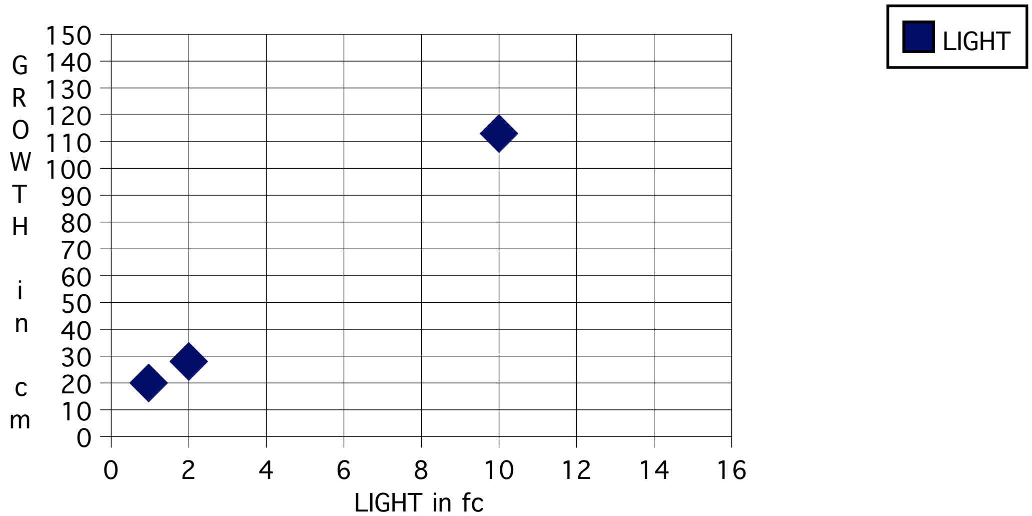
In Algebra terms:
Independent Variable is the cause, the X
Dependent Variable is the effect, the Y.

These can be stated as a qualitative or quantitative value. The relationship could be expressed as a bar graph, scatter plot, or "line" graph.
Y is a FUNCTION of X.

How light affects plant growth:
Could be:
No Light, plant is little
Some light, plant is normal.
Lots of light, plant is big

OR:

Light:	Height
1 fc	20 cm
2 fc	28 cm
10	114 cm



To determine the relationship, a student could find a "best fit" line or curve.

Y= 2X + 10 , so with NO light, the plant would be at 10 cm (Control Group= Y Intercept)

If there is more than one independent variable, bad experiment = Not a Function!

KEY ESSENTIAL QUESTIONS
MORNING:

EXPERIMENT:

HOW ________________ AFFECTS ___________________

-How would we help students be able to construct their hypothesis as cause/effect.

-What are the key parts to this experiment?

-After doing the experiment:

What scaffolding do students need? (Prior experiments, experience)

What skills do they need?

Which inquiry/numeracy/literacy standards for our grade does this address?

What extensions can we make?

-What are the key elements of a good lab report? Rubric for scoring lab?

AFTERNOON

How would we assess students on the skills we identified?

By critiquing another experiment, what are appropriate questions?

Examine sample questions:

Devise 5-10 other open ended questions/ multiple choice questions that address the inquiry/numeracy/literacy skills.

Examine the open ended rubric.

What does a 0, 1, 2, 3 look like for each question?

How do we assess students