

MEAL WORMS - SCIENTIFIC INQUIRY
Science and English/Language Arts

Grades: 9-12

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Acceleration Approach

Standard has been accelerated by moving grade level 9-12 up to the standard used for CAM and PASS.

1	2	3	4	5	6	7	8	9	CIM	CRLS/ CAM	PASS
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Organizing Overarching Concept (e.g., systems, patterns of change, models, scales)

Patterns of Change and Models

Organizing Higher Order Skills (e.g., Bloom’s, Paul’s Model of Reasoning)

Bloom’s Taxonomy – comprehension, application, analysis and synthesis

Differentiation Features - Students:

- Assigned fewer tasks to master standard of learning
- Use multiple higher-level skills
- Have additional variables to study
- Conduct original research
- Develop a product
- Make cross-disciplinary applications
- Use advanced resources
- Provided alternatives for tasks, products, and assessments
- Oral and written communication with a real world audience
- Use advanced resources

COMMON CURRICULUM GOAL

Science – Life Science - Interdependence

Understand the relationships among living things and between living things and their environments.

Science - Scientific Inquiry

Use interrelated processes to pose questions and investigate the physical and living world.

Forming the Question/Hypothesis

Formulate and express scientific questions or hypotheses to be investigated.

Designing the investigation

Design safe and ethical scientific investigations to address questions or hypotheses.

Collecting and presenting data

Conduct procedures to collect, organize, and display scientific data.

Analyzing and interpreting results

Analyze scientific information to develop and present conclusions.

English/Language Arts - Communication

Communicate supported ideas using oral, visual, written, and multimedia forms appropriate to topic, context, audience, and purpose.

English/Language Arts - Writing

Use a variety of modes in appropriate context. Use variety of written forms (e.g., journal and technical writing) to present ideas appropriate to audience and purpose.

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Archetypal Model

Form hypothesis, design study, conduct experiments, evaluate, and present results.

TASK DEMAND

Sample Task Activity for Regular Class

Interdisciplinary task: to determine the effect of different variables, e.g., food source, temperature, on a population of mealworms.

- Students will formulate a hypothesis to determine how their chosen variable will affect a population of mealworms. **Some examples:** Does the amount of available food have an effect on the size of the larvae? How does the fiber content of the mealworm's food affect the total number of mealworms and the ratio of adults to larvae?
- Students will design and carry out an experiment to answer the question posed in their hypothesis.
Example: Divide mealworms into three identical populations. Feed one population white flour, the second corn meal, the last bran cereal. Initial data should include number and size of mealworms, fiber content of the food, volume of food.
- Students will collect data every other day and record data and tentative conclusions in a journal.
Example: Count and weigh insects. Measure length of larvae. Record, using correct units. Compare current data with initial data.
- In addition to collecting data, students will receive instruction on statistics, specifically population and sampling size, mean and median, calculating statistical errors and determining uncertainty, precision of measurement tools, interpretation and presentation of data. (Students with calculus can study logistic model and carrying capacity as presented in text.)
- In order to further understand their project, students will read information regarding what is an ecosystem and carrying capacity. Games from *Project Wild* will be used to illustrate carrying capacity.
- During the last week of the study, the total data will be analyzed and written in an appropriate technical style: Introduction of Project, Materials Used, Data Summary, Results, Conclusions. In addition, the report will include predictions of expected results at six months and a year based on the results and conclusions.
- Finally, the teams will share their results with other teams and evaluate themselves and each other using CIM and PASS standards.

CONTENT STANDARDS

Life Science

Explain and analyze the interdependence of organisms in their natural environment.

Science - Scientific Inquiry

Make observations, formulate and express scientific questions or hypotheses to be investigated based on the observations.

Design scientific investigations to address and explain questions or hypotheses.

Collect and organize and display scientific data.

Analyze scientific information to develop and present conclusions.

English/Language Arts

Use a form of writing (to record, analyze, and express data and predictions) that other students in class can understand.

BENCHMARKS

Life Science - Interdependence and Scientific Inquiry

CIM - Based on observations and scientific concepts, ask questions or form hypotheses that can be answered or tested through scientific investigations.

CIM - Design a scientific investigation that provides sufficient data to answer a question or test a hypothesis,

CIM - Collect, organize and display sufficient data to facilitate scientific analysis and interpretation.

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Questions

- Does the amount of available food have an effect on the size of the larvae?
- How does the fiber content of the mealworm's food affect the total number of mealworms and the ratio of adults to larvae?
- How will you design and carry out an experiment to answer the question posed in your hypothesis?
- What would you predict of expected results at six months based on the results and conclusions?
- What would you predict of expected results in a year based on the results and conclusions?

Alternative Task Activity for High-end Learner—Students will:

- Do advanced level research using more complex research design and variables.
- Work directly with a scientist for feedback on research model.
- Formulate a hypothesis.
- Design and carry out an experiment to answer the question posed in their hypothesis.
- collect data.
- Apply skills of using statistics, specifically population and sampling size, mean and median, calculating statistical errors and determining uncertainty, precision of measurement tools, interpretation and presentation of data.
- Read advanced information relating to the current research related to the hypothesis.
- Analyze data and write in an appropriate technical style.
- Share their results with other like ability students, a scientist and evaluate themselves and each other using CIM and PASS standards.

Questions for Alternative Task Activity

- How will you frame your scientific problem?
- How will you design and carry out an experiment to answer the question posed in your hypothesis?
- What would you predict of expected results at six months based on the results and conclusions?
- What would you predict of expected results in a year based on the results and conclusions?
- In what field will you find your scientist?
- What role will the scientist play in your research?

CIM - Summarize and analyze data, evaluating sources of error or bias. Propose explanations that are supported by data and knowledge of scientific terminology.

English/Language Arts - Communication

CIM - Listen critically and respond appropriately to oral communication.

CIM - Formulate judgments about ideas under discussion and support those judgments with convincing evidence.

English/Language Arts - Communication

Communicate supported ideas using oral, visual, written, and multi-media forms in ways appropriate to topic, context, audience, and purpose.

CIM - Present and support clear thesis statement and choose appropriate types of proof (e.g., statistics, testimony, specific instances) that are credible, valid and relevant.

CIM - Apply knowledge of word origins, word relationships, and context clues to determine the meaning of new words encountered in reading materials and use those words accurately.

CIM - Understand technical vocabulary in subject area reading.

English/Language Arts - Writing

Use a variety of modes in appropriate context. Use a variety of written forms to express ideas appropriate to audience and purpose.

CIM - Write analytical essays and research reports:

- a. Gather evidence in support of a thesis including information on all relevant perspectives.
- b. Convey information and ideas from primary and secondary sources accurately.

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Implementation Time

- 9 weeks

Resources

For each student team:

- 60 mealworm larvae and 30 adults (can purchase from Carolina Biological supply (1-800-227-1150) <http://www.carolina.com/>).
- Note: Mealworms complete their life cycle in seven to nine weeks: eggs hatch in 14 days, larva--four weeks, pupa--one to three weeks. Adults can live three to five months. Adults do not fly.
- 3 containers for mealworms per team.
- Mealworm food (e.g., oatmeal, flour, cornmeal, bran-cereal volume range: 1 cup is low to 5 cups high).
- Access to scales, measuring cups, rulers, water, misting bottle, graph paper.

Books

- Odum, E. (1997) *Ecology: A Bridge between science and society*. Publisher: Sinauer Associates, Inc. (chapters on carrying capacity, defining ecosystem)
- Hallett, D. Gleason, A. and McCallum, W. (1997). *Calculus: single variable*. John Wiley & Sons Publishers. (pp 91 and 518--information on logistic model and carrying capacity (for students using calculus).
- Weiss, N.A. and Hasset, M.J. (1999). *Introductory statistics*. 5th ed. Menlo, CA: Addison-Wesley Publishing Co.

Internet

- Carolina Biological Supply Company <http://www.carolina.com/>
- *Project Wild* Federal Department of Fish and Wildlife (Games to illustrate carrying capacity) http://www.state.ak.us/adfg/wildlife/geninfo/educate/pw_home.htm

Resources for High-end Learner's research:

- Scientist/researcher from university or business/industry.
- Advanced level science texts/periodicals
- University level lab guides
- Saturday Academy

- c. Make distinctions between the relative value and significance of specific data, facts, and ideas.
- d. Include visual aids by employing appropriate technology to organize and record information on charts, maps, and graphs.
- e. Anticipate and address readers' potential misunderstandings, biases, and expectations.
- f. Use technical terms and notations accurately.

PASS - SCIENCE

Design and Conduct Scientific Investigations

Design and conduct experiments using principles of scientific inquiry. Investigative processes of the sciences, scientific instruments, and technology. Collect and analyze data, critique experimental designs. Communicate scientific problems, results, and arguments.

Formulation of Questions and Hypotheses

Determine areas of inquiry, frame scientific problems, and pose research questions and hypotheses involving scientific relationships.

Design of Investigation

Design scientific investigations that use precise and appropriate methodology to address questions, examine scientific relationships, and test hypotheses.

Collection of Data

Conduct scientifically accepted procedures to collect, organize, and display data.

Analysis and Interpretation

Analyze and interpret data and relationships, evaluate investigations, and develop supported explanations.

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SCIENCE

Scoring Guides - (See Standards and Assessments Section VII.)

Use the Scientific Inquiry Scoring Guide

<http://www.ode.state.or.us/asmt/resource/scorguides/scienceinq10.pdf>

ENGLISH/LANGUAGE ARTS - SPEAKING

Scoring Guide - (See Standards and Assessments Section VII.)

Ideas and Content

Organization

Language

Delivery

<http://www.ode.state.or.us/asmt/resource/scorguides/speakingscoringguide.pdf>

PASS - ENGLISH

Write for Varied Purposes

Write clearly, coherently, and effectively in a range of modes to discover and convey meaning.

Quality of Thinking (Ideas and Content)

Develop, support, and convey clear, focused, and substantive ideas in ways appropriate to topic, context, audience, and purpose.

Organization and Coherence (Organization) Organize writing in clear, coherent sequences, making connections and transitions among ideas, paragraphs, and sentences.

Style and Technique (Sentence Fluency and Word Choice)

Use and vary sentence structures, word choices, and writing voice to achieve clear and fluent writing.

Conventions and Format (Conventions and Citing Sources)

Use correct spelling, grammar, punctuation, capitalization, paragraph structure, sentence construction, formatting, and, when appropriate, citations.

Purposes, Modes, and Forms

Write for varied purposes in a variety of modes and forms.

Writing Process

Use effective processes to generate, compose, organize, revise and present writing.

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TAG NEEDS ADDRESSED

INTELLECTUALLY GIFTED	ADVANCED SCIENCE KNOWLEDGE/SKILLS	ACADEMICALLY TALENTED MATH	ACADEMICALLY TALENTED ENG/LA	CAREER RELATED LEARNING STANDARDS FOR CAM - Certificate of Advanced Mastery	TEACHER CHECKS THE BENCHMARK LEVEL STUDENT IS PURSUING
<input checked="" type="checkbox"/> Advanced Critical Reasoning <input checked="" type="checkbox"/> Scholarly Interaction <input checked="" type="checkbox"/> Continuous Progress for Level and Rate* <input checked="" type="checkbox"/> Challenging Resources <input type="checkbox"/> Effecting Change <input type="checkbox"/> Decision Making; Ethical Use of Influence <input type="checkbox"/> Leadership Training/Career <input type="checkbox"/> Realistic Goal Setting <input checked="" type="checkbox"/> Regular Interaction with Intellectual Peers <input type="checkbox"/> Social-Emotional Issues; Support; Coping Strategies <input checked="" type="checkbox"/> Advanced Academic Planning <input type="checkbox"/> Opportunity for Competition/Failures/Successes <input type="checkbox"/> Creative Problem Solving with Real Problems/Audiences <input checked="" type="checkbox"/> Pursuit of Advanced Level Research <input type="checkbox"/> Advanced Vocabulary Development	<input checked="" type="checkbox"/> Advanced Critical Thinking in Science <input checked="" type="checkbox"/> Continuous Progress/Level and Rate* in Science <input checked="" type="checkbox"/> Challenging Science Resources <input checked="" type="checkbox"/> Creative Problem Solving Strategies in Science <input type="checkbox"/> Science Advanced Vocabulary Development <input type="checkbox"/> Leadership Training/Career <input type="checkbox"/> Decision Making; Ethical Use of Influence <input checked="" type="checkbox"/> Regular Interaction with Talented Science Peer <input type="checkbox"/> Realistic Goal Setting <input type="checkbox"/> Opportunity for Competition/Failures/Successes <input checked="" type="checkbox"/> Advanced Academic Planning in Science <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>* Rate requires monitoring to ensure that the student was allowed to move ahead upon acquiring concepts.</p> </div>	<input checked="" type="checkbox"/> Advanced Critical Thinking in Math <input checked="" type="checkbox"/> Continuous Progress/Level and Rate* in Math <input checked="" type="checkbox"/> Challenging Math Resources <input type="checkbox"/> Creative Problem Solving Strategies in Math <input type="checkbox"/> Math Advanced Vocabulary Development <input type="checkbox"/> Leadership Training/Career <input type="checkbox"/> Decision Making; Ethical Use of Influence <input type="checkbox"/> Regular Interaction with Talented Math Peers <input type="checkbox"/> Realistic Goal Setting <input type="checkbox"/> Opportunity for Competition/Failures/Successes <input type="checkbox"/> Advanced Academic Planning Math	<input type="checkbox"/> Advanced Critical Thinking in LA <input checked="" type="checkbox"/> Continuous Progress/Level and Rate* in LA <input checked="" type="checkbox"/> Challenging LA Resources <input type="checkbox"/> Creative Problem Solving Strategies in LA <input type="checkbox"/> Advanced Vocabulary Development <input type="checkbox"/> Leadership Training/Career <input type="checkbox"/> Decision Making; Ethical Use of Influence <input type="checkbox"/> Regular Interaction with Talented LA Peer <input type="checkbox"/> Realistic Goal Setting <input type="checkbox"/> Opportunity for Competition/Failures/Successes <input type="checkbox"/> Advanced Academic Planning in LA	<input checked="" type="checkbox"/> Personal Management <input checked="" type="checkbox"/> Problem Solving <input checked="" type="checkbox"/> Communication <input checked="" type="checkbox"/> Teamwork <input checked="" type="checkbox"/> Employment Foundations <input type="checkbox"/> Career Development	<p>Math:</p> <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> CIM <input type="checkbox"/> CAM <input type="checkbox"/> PASS <p>English/LA:</p> <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> CIM <input type="checkbox"/> CAM <input type="checkbox"/> PASS <p>Science:</p> <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> CIM <input type="checkbox"/> CAM <input type="checkbox"/> PASS
<p>Student _____ Grade _____</p> <p>Teacher _____ School _____</p> <p>Date Initiated _____ Date Completed _____</p> <p>Check TAG Identification category:</p> <p><input type="checkbox"/> Intellectual <input type="checkbox"/> Academic Math <input type="checkbox"/> Academic LA</p>					