NanoLeap

NanoLeap Chemistry Module
Nanoscale Materials and Their Properties

Preface and Overview

Overview
The NanoLeap Chemistry Module is designed to be a three-week *culminating unit* in a high school chemistry course. The module asks students to *apply* concepts and skills learned throughout the year in a traditional curriculum and can serve as an *extension* of those concepts that are of particular relevance in nanoscale science.

Nanoscience and nanotechnology are rapidly expanding fields of science and many of the techniques and scientific concepts involved in the research and development of applications and products require a graduate level background in chemistry, physics, materials science, and technology. Therefore, a deliberate decision was made to include in these NanoLeap materials only those properties and changes in physical and chemical properties observed at the nanoscale that can be explained in terms understood by most first-year secondary chemistry students.

The essential question that students will consider throughout the module is, "**How and why do the chemical and physical properties of nanosamples differ from those of macrosamples of the same substance?"**

Lessons and Timelines*:*
There are three units in this module in addition to the Poster Assessment. The units are divided into several lessons. Please see the *Student Handbook-Teacher Version* for instructional guidance.

In addition, there is a pre- and post-assessment and a Poster Assessment to complete during the course of the module. A suggested timeline follows:

Table 1: Module Scope and Sequence

Estimated Time	Module Component(s):
45 minutes	**Pre-Assessment**
270 minutes	Unit 1: ***Nanoscience: What is it?*** Lessons 1.1, 1.2, and 1.3
55 minutes*	**Poster Assessment introduction**
330 minutes	Unit 2: ***Metallic and Ionic Nanoparticles: Extendable Structures*** PowerPoint Lessons 2.1, 2.2, and 2.3
150 minutes	Unit 3: ***Neat and Discrete Nanoparticles*** PowerPoint Lessons 3.1 and 3.2
165 minutes *	**Poster Assessment student preparation, research, and peer reviews of drafts**
55 minutes	**Poster Assessment Fair**
45 minutes	**Post-assessment**

*You may need to plan additional in-class time for students to choose a topic, research their topic, plan the poster layout with their group, and for peer reviews of drafts and layouts. See Poster Assessment instructions in the Student Handbook-Teacher Version for more information.

The authors propose several unit sequences:

- Unit 1 as a stand alone
- Unit 1–2 only
- Unit 1–3 only
- Units 1, 2, and 3 (complete module)

Overview of Instructional Materials

Teacher PowerPoints and Scripts

The Teacher PowerPoints and Scripts contain background information, suggested procedures, instructional strategies, annotated student handbook, glossary, and appendices. The Teacher Script is formatted in a landscape view and allows the teacher to correlate the PowerPoint slide, corresponding instructional materials, student handbook, and preview upcoming instruction. Each lesson contains the student objectives, a preview of highlights-"at a glance for the teacher," estimated teaching time, materials for activities, demonstrations, and Web site URL addresses. Additionally "Making Connections" questions are provided at the end of each lesson for formative assessment and to foreshadow the upcoming lesson. The "Module Lesson Flow Chart" is provided to let the student review each lesson's essential question. The text of the script is structured such that background information and pedagogy are in *italics* and the suggested teacher script is in **bold.**

The PowerPoint format for each lesson is accompanied with a scripted text that incorporates a teacher directed discussion technique. The questions in the script and possible student answers aid the teacher in facilitating discussion. This is a rather unique application of PowerPoint slides as they are typically used for lecture-type presentations.

Before using this classroom technique, review the guidelines for successful use of Questioning and Whiteboarding as outlined in the Instructional Strategies section. Study the questions in the script carefully to determine whether or not the terminology used is different from that used in your chemistry curriculum and to decide whether or not it will be necessary for you to include additional background material into the script to incorporate or extend your students' classroom experience before posing a particular question. One of the overall goals of the NanoLeap materials is to help high school students learn how their chemistry background applies to the nanoscience world.

The questions themselves have been carefully worded so that they provide students the opportunity to apply their previous chemistry experiences in their answers. Remember, it requires some thought time to formulate meaningful answers to application and synthesis questions, so incorporate enough "wait time" (a minimum of three to five seconds) for this to occur.

The script that accompanies this PowerPoint component is formatted for ease of use. Here is an example:

Table 2: Sample Teacher Guide

Slide # Student Journal Page #	*Teacher Background Information and Pedagogy* **Teacher Script**
Slide 1 Instructional Strategies: Page 3	*1) Have students complete the first column of the K-W-L chart for the question, What is Nanoscience? before they watch the video. Then, following the video:* **You have just watched a video on Nanoscience and Nanotechnology, so let's explore this new field of science further by searching for answers to some questions about it. We have been considering what you know about nanoscience. On the basis of what you saw in *NanoSize Me,* how would YOU define nanoscience?** {Click} *2) Have students revise their notes on the first column and complete the second column*

	after they watch the video. *Follow instructions found on Teacher Background page 3 of the Instructional Strategies section of the Teacher Handbook.* *Accept student answers, which may include: it is the relatively new field of science that deals with very small particles or the different properties that common chemicals have at the nanoscale level or possible future uses.* *Pilot students said," small, tiny, really small, too small to see." They only mentioned examples from the video.*
Slide 2 Fact Sheet 1 – SI Units Student Handbook-Teacher Version: Page 5 Student Handbook: Page 3	*3) Have students refer to the Common SI Prefixes table found in the Student Handbook on page 4.* **Nanoscience starts with the same prefix as nanometer.** **1. What is a nanometer? How large is a nanometer?** *one billionth of a meter or 10^{-9} meter*

Student Handbook-Teacher Version
The Student Handbook-Teacher Version, is the annotated teacher version with the answer key for the Student Handbook. The teacher version contains exactly the same pages found in the student version and the teacher version of these pages with suggested answers.