

# **All That Glitters is Not Gold. Extending Scientific Thinking to Analyze Manufacturers' Claims on Consumer Products**

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## **Overview**

Every public forum is populated with advertisements for artificial products that claim to correct or enhance body features. Scientific method provides an approach through which scientific questions can be answered. This approach can be extended to real world choices like one that requires a consumer to decide on whether or not to use an artificial product based on the manufacturers' claims. Given that high school students are required to learn the scientific method, it would add value to their learning experience if the application of this method is connected to their real world choices. The purpose of this unit is to encourage high school students to use the scientific method approach to make rational choices when they are targeted by these manufacturers through advertisements.

## **Rationale**

Self esteem is an important factor among adolescents attending high school. Appearance is a major issue that affects self esteem. Appearance ranges from skin tone, size and volume of hair to the overall weight and body figure. The adolescents who perceive to have shortcomings in any of these areas settle for an inferiority complex or look for ways to correct the anomalies and improve their appearance or focus on other sources of self esteem. These products range from skin corrective remedies, hair growth products, and weight loss products to steroids. The companies that manufacture products that claim to have solutions to these anomalies produce advertisements that often prey on these students' perceptions.

More often than not, the choice whether to use these products is determined by how affordable they are. Given that some of these products have exaggerated or false claims,

and in most cases have side effects, high school students can apply a scientific method approach to make a rational decision on whether to use a product or not.

Most students start working at high school level. This implies that at this stage the students make purchases based on their preferences. A study conducted at an Australian city concluded that advertisements developed to appeal to adults for products for children were more effective than advertisements for the same products directed at the children because ultimately the decision to purchase is made by the parents. (Jones & Fabrianesi, 2008). Manufacturers therefore make advertisements targeting high school students since these students can afford to make their own purchases.

According to Byrd-Bredbenner and Grasso (2000) media advertisement not only cause teenagers to desire some food products or supplements, but also influence these adolescents to believe that these products are superior or required alternatives to healthy natural alternatives. In some cases some information is withheld like the effect of milk on lactose intolerant people for milk product advertisements or the effect of consuming too much of drinks advertised as vitamin C rich juices, due to the high level of sugar. Likewise, as noted by Adams, Tyrrell and White (2011), advertisers persuade a consumer to select the advertised products over healthier alternatives notwithstanding that the products may have unfavorable consequences like obesity. A student who is well equipped with scientific knowledge and has been accustomed to scientific practices like asking questions when presented with information such as the claims in advertisements is more likely to make a better informed judgment when these advertisements are either misleading or incomplete.

If a student's mindset can be conditioned to transfer scientific skills to real life situations like the evaluation of a media advertisement, they are more likely to make well informed decisions. For instance knowledge of the daily required types of vitamins and minerals and their respective amounts, the natural sources of these substance and the benefits vis-a-vis risks of the artificial substances are likely to help these students determine whether they need to take the supplements or not. However, advertisements are here to stay. Efforts to protect the consumer from making purchase decisions based on advertisements dates back to more than a century ago (Galdston, 1931) yet, undeniably there have always been ways to circumvent the conditions set by these consumer organizations. In addition these advertisements are important components of businesses and ultimately help drive a country's economy.

### Scientific method

Scientific method "is a strategy for drawing sound conclusions" (Myers, Oldha and Tocci, 2004, p.46). This strategy includes a series of iterative activities like making and recording observations, asking questions related to the observations, seeking explanations to specific scenarios or identifying problems that need to be solved. Other activities

include proposing informed hypothesis, designing experiments to test hypothesis, analyzing data collected, making conclusions and reporting the findings for future review or reference by other people. The diagram below shows the iterative activities involved in scientific method.

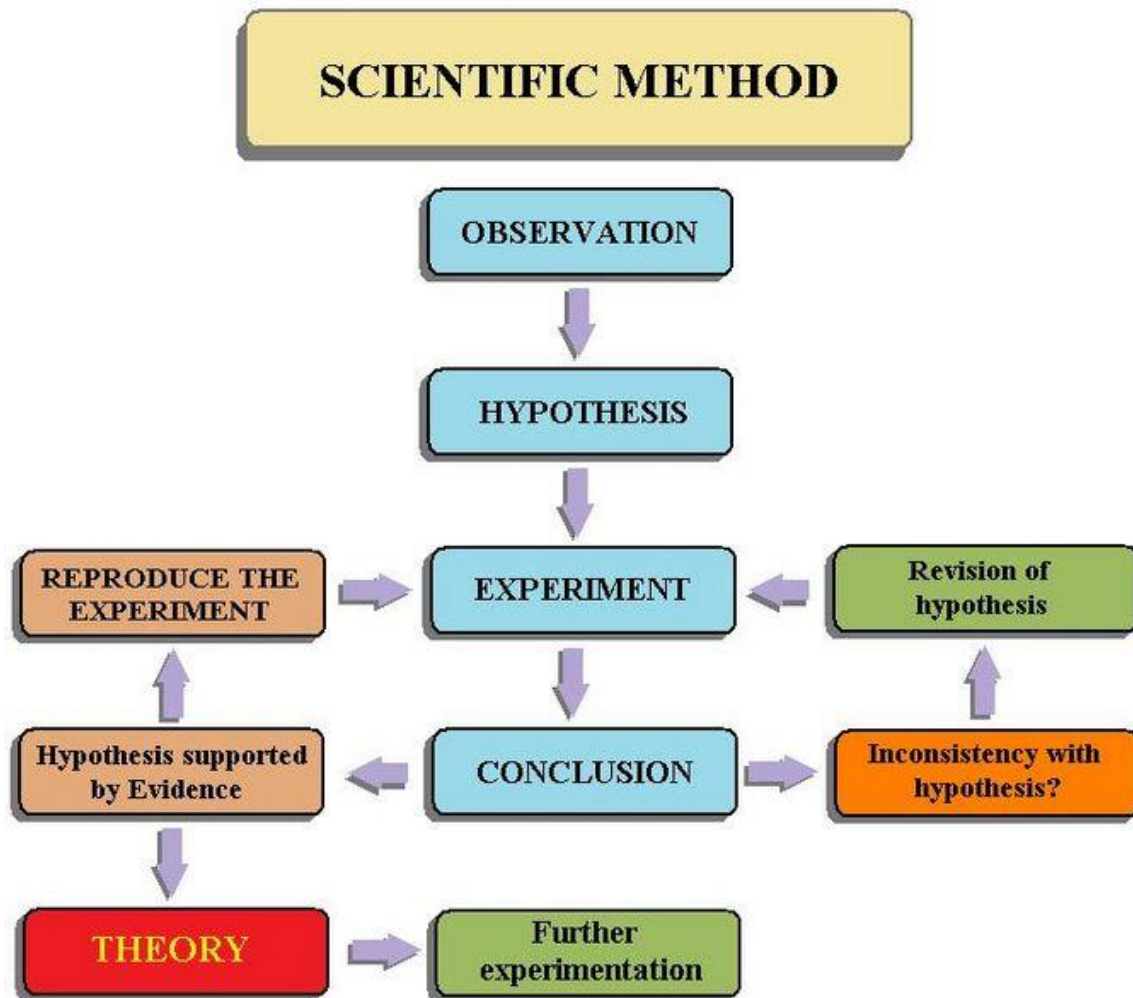


Figure from <http://www.conservapedia.com/File:ScientificMethodflowchart.jpg>

Driver et al., (1994) have argued that in line with constructivist view in which knowledge is assumed to be cumulatively added onto existing knowledge, scientific knowledge can also be build onto existing learners' knowledge derived from the learners' experiences and social interactions. Consequently, students should be presented with scenarios that they can relate to, in order to allow them to apply the scientific practices in class.

In order to support good science practices, these activities require a set of skills like an inquisitive mind, attention to details, critical evaluation of information, making logical deductions, information research, effective experiment design and good communication skills among others. When students are trained to use scientific method to solve problems, the students acquire these skills and the more they carry out the scientific method activities the more they improve on these skills. Besides, a study by Crawford, Kelly and Brown (2000) concluded that when students are given a chance to extend their scientific exploratory thinking to their personal and communal lives, they are likely to be more engaged and see the connection between science and their lives.

Students often have a misconception that the scientific method is a series of steps used by scientists in academic labs and other research institutions. Ultimately students should be made to understand that the scientific method is also applicable in smaller scales and in a variety of settings outside the research labs. Besides, at all times, students encounter situations in which they question things that happen out of the ordinary, think of a possible explanation for this unusual occurrence and unconsciously test their hypothesis by trying out a few things. By drawing the parallel of these situations to the scientific method, educators can effectively demonstrate the application of scientific method to the students' lives.

Scientific method requires and supports good critical thinking skills. According to Critical thinking community (2011), critical thinking goes beyond acquiring knowledge and skills in that it requires the development of a habit in which the knowledge is used to inform a person's decisions and behaviors at all times though a well thought out process. This thinking process employs other high order thinking skills like application, evaluation, synthesis, analysis among others (Critical thinking community, 2011). This implies that the constant use of scientific practices by students provides a gymnasium for practicing and polishing the students' critical thinking skills. This eventually can develop the critical thinking into an important habit for the students.

Students should be encouraged to practice on the use of scientific method by providing them with problem solving cases in the form of case studies, group investigation among other methods. Depending on the ability of the students, they can be presented with structured, semi structured or unstructured cases and they would be asked to provide a solution with a rationale to the problems contained in those cases. Scenarios may be presented as case studies or as investigations in which they would be required to design a controlled experiment. Repeated use of the scientific practices is likely to impact and encourage critical thinking skills among the learners (Holt, 2004).

## **Objectives**

This unit is intended for high school students, grades 9 – 12. While the structure of curriculum differs from one school to the other, students are required to take a minimum of three years of science in order to fulfill the graduation requirements. Generally within the first years students are taught Physical science and Biology. In their junior year students get Chemistry and those who choose to take a fourth science can choose from a variety of electives like Physics, Environmental science among other electives. The expectation is that students are exposed to scientific practices throughout their science courses.

The objectives of this unit are aligned with the Pennsylvania standards (see Appendix A).

The objectives of this unit will be:

- Students will be able to describe the activities involved in the scientific method activities and relate these activities to classroom investigations as well as some situations in their daily lives
- Students will be able to propose a hypothesis and design a plan to test their hypothesis given some short hypothetical scenarios
- Read and analyze a case study on an advertisement related to consumer products
- Determine whether the claims in the advertisement are justifiable
- Document the findings
- Students will select a specific advertisement for a consumer product of their own interest
- Develop a list of questions that would be used to assess the claims of a specific product as presented in a specific advertisement
- Design a plan on how to answer these questions
- Conduct research, including reviewing the research literature and/or experiment, as needed
- Students will select collect analyze data related to the product of their choice
- Students will compile a report to communicate their findings
- Analyze and interpret data
- Provide a conclusion with a justification
- Write a report to document the process, findings and conclusion

## **Strategies**

Classroom demonstration

Whole class discussion

Group activity/Pair sharing

Class demonstration with discussion

Students can be taken through a learning experience in which they employ the scientific method without initially describing the scientific process. There are a number of intriguing scientific activities that can be used for this purpose in all the science content areas. After the activity, a reflective discussion can be used to describe the logical steps of the scientific method employed in that scientific activity. An example of such an activity is included in lesson one of this curriculum unit.

Group activity/Pair sharing

Students can then be asked to discuss in pairs situations in which they have used all or some of the scientific method activities. Sample groups can share their discussion to the whole class to further demonstrate the application of scientific method to the student's daily lives.

### **Classroom Activities**

Lesson 1 Scientific processes (2 periods)

Lesson 2 Criteria for evaluating advertisements. Case Study (1 period)

Lesson 3 group Project (1 period)

Lesson 4 Analyze data, produce a report and present results  
(2 periods)

Lesson 1: Scientific processes

Objectives

- Students will be able to describe the activities involved in the scientific method activities and relate these activities to classroom investigations as well as some situations in their daily lives
- Students will be able to propose and explain situations in which they have applied some or all the activities of the scientific method

Class demonstration with discussion

I like to introduce the scientific method with an activity. I present my students with the same volume of two clear liquids in identical flasks with label A on one of them and label B on the second. As I carry out the demonstration, we have a class discussion guided by the following questions

Describe the differences and similarities between the two liquids.

What do you think the liquids are?

Why did you suggest these liquids?

How could you determine what liquid it is likely to be?

What conclusions would you make?

Is it possible to make a definite conclusion?

These questions present an opportunity to review or introduce concepts like physical properties when the students are describing the two liquids, viscosity especially as a basis of eliminating oils that are clear liquids. The students give a range of possible clear liquids. Some chemical properties of some of these liquids are also discussed as the class brainstorms on possible tests on these liquid. The responses given for the possible tests allows for a discussion on safe practices while carrying out scientific investigations because often student are quick to point out that one can taste, smell or feel the liquids to identify them.

I test the liquids by placing a burning matchstick on some test amount from each liquid in a Petri dish. I like to start with liquid A, water, which puts out the matchstick. Liquid B, alcohol, burns. While I do this activity I describe the lab apparatus required and also demonstrate a safe way of putting out the fire is to cover the Petri dish at which point I ask the students why that works. In most cases the students identify the liquids correctly but a discussion ensues to make the

Period 2 Scientific processes

Objective

- Students will be able to propose a hypothesis and design a plan to test their hypothesis given some short hypothetical scenarios

Strategy

Group discussion

In groups of three or four, students will discuss specific scenarios that will be provided with guiding questions. These scenarios will familiar scientific and nonscientific observations that require a problem solving strategy similar to the scientific method. The groups will then report their findings to the whole class for further discussion if need be. An example of a nonscientific scenario would be one in which a student sends a package to a friend and a week later, the friend confirms they have not received the package. Then the group would be required to state a hypothesis of what would have likely occurred, devise a strategy to test the hypothesis and discuss possible findings. A scientific based example would be that a student makes an observation that the leaves from one side of their indoor plant have withered. The group would discuss this scenario and brainstorm on possible hypothesis, design a strategy to test their hypothesis and report on possible explanations.

## Lesson 2: Criteria for evaluating advertisements. Case Study (1 period)

### Objectives

- Students will analyze an advertisement for a sports drink and identify the explicit and implicit claims by the manufacturers
- Students will evaluate the claims based on existing research and determine the validity of these claims
- Students will report their findings

### Strategies

#### Case Study

The whole class will watch a video on a Gatorade commercial titled “HOW DO YOU one-up the competition?” A classroom discussion will ensue to digest students understanding of the commercial. The students will then be asked to answer the guiding questions in small groups and compile a report to be presented out by one student to the whole class. Groups will be provided with computers, reference books health journals and magazines for their research

In one of the leading commercials for Gatorade products (<http://gatorade.com/oneup#Video>), a video clip for a basket ball between Miami Heat and Oklahoma city Thunder basket ball teams show a dramatic match-up between these teams in the last minutes of the game. At the beginning of the clip Kevin Durant powerfully dribbles the ball past Miami players only to be blocked by Dwyane Wade and therefore misses a chance to make a winning shot. Following this, Kevin is seen strategizing after which he comes up with a winning formula for working out very hard supported by Gatorade products. Kevin can be seen replenishing his thirst and boosting his energy with Gatorade products during the work outs. In a following match up, his strategy pays off. Kevin is able to push forward against Miami players to make a winning shot at the last seconds of the game. Towards the end of the screen an effective caption with the words “Win from Within” is displayed.

It is often quoted that a picture is worth a thousand words. Undeniably a video is worth many more words and emotions too. This video creates an impression that is well summed by the caption that the power exhibited by the athletes comes from within fueled by the Gatorade consumed by these athletes. With no further information provided, a high school athlete might be persuaded by this advertisement to use Gatorade products to improve their performance.



In order to analyze this advertisement, the following guiding questions will be used by students to research, discuss and give their views in small groups of three or four students. There are some suggested websites provided in the student's references section that may be used to address these questions.

1. What are the direct claims from Gatorade manufacturer on the need to consume Gatorade products?
2. What claims are indirectly implied from Gatorade manufacturer on the need to consume Gatorade products?
3. What research has been done to justify these claims?
4. Are there conflicting research studies that have been done? If so what contradictory information do these research studies offer?
5. What are the consumer reviews on these products?
6. Are there risks reported by the manufacturer or any other credible organization associated with this product?
7. Why would I want to use or not use this product?
8. Are there customer comments or research reports that support my reasons for using this product?
9. Are there customer comments or research reports that contradict my reasons for using this product?

### Lesson 3: Group project (1 period)

#### Objectives

The objectives of this unit will be:

- Students will select a specific advertisement for a consumer product of their own interest
- Develop a list of questions that would be used to assess the claims of a specific product as presented in a specific advertisement
- Design a plan on how to answer these questions
- Conduct research, including reviewing the research literature and/or experiment, as needed

#### Group Project

Students will be encouraged to work in groups of about 4 students. Each group will specify a product of their choice that they will investigate. The group will choose one of the leading commercials associated with that product for analysis. Among other tasks developed within the group, each group will be expected to;

1. Research information concerning the product and manufacturer's claims. List all the claims from the manufacturer.
2. Review research studies supporting manufacturer's claims. Write the evidence for each of the claims listed.
3. Evaluate the studies against other studies, customer reviews and known scientific facts.
4. Are there studies with contrary evidence? Does the evidence contradict any scientific facts?

Example of products to choose from

1. Skin care product
2. Health drinks
3. Vitamin supplements
4. Sport drinks
5. Weight loss products
6. Steroids
7. Hair growth products
8. Cleaning products
9. Electronic products

Lesson 4: Analyze data, produce a report and present results  
(2 periods)

Objectives

- Students will select collect analyze data related to the product of their choice
- Students will compile a report to communicate their findings
- Analyze and interpret data
- Provide a conclusion with a justification
- Write a report to document the process, findings and conclusion

Students will continue to work in groups to gather information and perform experiments for testable aspects of their hypothesis within the classroom setting.

The students will then compile a final report. Groups will be given a choice to present their reports as power point presentations, posters or podcasts.

### **Annotated Bibliography/Resources**

Student sources

<http://gatorade.com/oneup#Video>

This is a link to the Gatorade commercial referenced in the case study.

<http://www.gatorade.com/history/default.aspx>

This is the official website of Gatorade that provides information on the development of this line of products, scientific basis of the manufacturer and associated health claims.

<http://www.livestrong.com/article/82204-sport-drinks-nutrient/>

This article is from a website associated with Livestrong cancer foundation and provides an objective analysis of sport drinks nutrient facts.

<http://www.utsandiego.com/news/2011/feb/22/exploring-myths-and-facts-surrounding-sports/>

This is a newspaper article on Exploring myths and facts surrounding sports drinks

<http://www.examiner.com/review/product-review-gatorade-energy-performance-and-recovery-supplements>

This website provides a Product review: Gatorade – energy, performance and recovery supplements

<http://www.viewpoints.com/Gatorade-G2-reviews>

This website provides a review of Gatorade G2 product with comments that address specific claims or issues

<http://www.amazon.com/Gatorade-G-Series-Carb-Energy-Chews/product-reviews/B007R651X6>

This website provides a review of Gatorade G - series product with comments that address specific claims or issues

### Scientific Practices and their application

Crawford, T., Kelly, G. J. and Brown, C. (2000), Ways of Knowing beyond Facts and Laws of Science: An Ethnographic Investigation of Student Engagement in Scientific Practices. *J. Res. Sci. Teach.*, 37: 237–258. doi: 10.1002/(SICI)1098-2736(200003)37:3<237::AID-TEA2>3.0.CO;2-6

As presented in the abstract, this article describes “Events in a combined fourth- and fifth-grade elementary class were studied to document how the participating teacher provided opportunities for students to diverge from the intended curriculum to pursue their questions concerning the behavior of sea animals in a marine science observation tank.

Critical thinking community (2011). The critical thinking community *Defining critical thinking*. Retrieved from <http://www.criticalthinking.org/pages/defining-critical-thinking/766>

This website provides a comprehensive definition of critical thinking and its historical background. It also provides research reports related to critical thinking and fundamentals and varying views of critical thinking principles.

Driver, R., Asoko, H, Leach, J, Mortimer, E., Scott, P. (1994). Constructing Scientific Knowledge in the Classroom; *Educational Researcher* , 23(7), 5-12.

As discussed in the article’s abstract “This article, which presents a theoretical perspective on teaching and learning science in the social setting of classrooms, is informed by a view of scientific knowledge as socially constructed and by a perspective on the learning of science as knowledge construction involving both individual and social processes” (p.5)

Myers, R. T., Oldha, K. B.,& Tocci, S.(2004). *Chemistry*. New York: Holt, Rinehalt and Winston.

This is a high school chemistry textbook.

## Objectives and structure of advertisements

Adams, J., Tyrrell, R., & White, M. (2011). Do television food advertisements portray advertised foods in a 'healthy' food context? *The British Journal of Nutrition*, 105(6), 810-5. doi: <http://dx.doi.org/10.1017/S0007114510004435>

This article discusses the misleading information that is often contained in food advertisements to brand such foods as healthy.

Byrd-Bredbenner, C., & Grasso, D. (2000). Health, Medicine, and Food Messages in Television Commercials During 1992 and 1998. *Journal Of School Health*, 70(2), 61

Given the considerable amount of time spent watching television (electronic media in general today) by adolescents, this article explains how advertisers are using this media to target this audience.

Galdston, I. (1931). Hazards of Commercial Health Advertisements, *American journal of public health and the nation's health*, 21(3), pp. 242 – 248

Like the other articles in this category, this report describes the influence of advertisers on consumers' choices, regardless of healthier or cheaper alternatives. This article was chosen to demonstrate that this is not a recent phenomenon, but one that is more than a century old.

Jones, S., & Fabrianesi, B. (2008). Gross for kids but good for parents: Differing messages in advertisements for the same products. *Public Health Nutrition*, 11(6), 588-95. doi: <http://dx.doi.org/10.1017/S1368980007000894>

This article reports the finding of a study that investigated the influence of the design of advertisements for children's food based on whether the design was tailored to appeal to the adults or the children.

## **Appendix/Content Standards**

### **PEENYSYLVANIA SECONDARY STANDARDS (Biology, Chemistry, Physics) Science and Technology and Engineering Education**

#### **3.2. Physical Sciences: Chemistry and Physics**

##### **A. Chemistry**

1. Properties of Matter
2. Structure of Matter
3. Matter & Energy
4. Reactions
5. Unifying Themes
6. Science as Inquiry

##### **B. Physics**

1. Force & Motion of Particles and Rigid Bodies
2. Energy Storage and Transformations: Conservation Laws
3. Heat / Heat Transfer
4. Electrical and Magnetic Energy
5. Nature of Waves (Sound and Light Energy)
6. Unifying Themes
7. Science as Inquiry

#### **3.3. Earth and Space Sciences**

##### **A. Earth Structures, Processes and Cycles**

1. Earth Features and the Processes that Change It
2. Earth's Resources / Materials
3. Earth's History
4. Sciences and Transfer of Energy
5. Water
6. Weather and Climate
7. Unifying Themes
8. Science as Inquiry

##### **B. Origin and Evolution of the Universe**

1. Composition and Structure
2. Unifying Themes
3. Science as Inquiry