TEACHING ELEMENTARY SCHOOL STUDENTS ABOUT RESPIRATORY HEALTH

By

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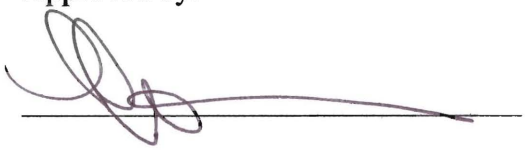

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STATEMENT BY AUTHOR

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Introduction

Numerous studies have been done correlating childhood asthma with childhood exposure to irritants in the air like second hand smoke and mold residue. Despite all of this research, many children still face respiratory struggles regularly due to their lack of knowledge on the subject. If the population can be educated about the long-term risks of breathing ‘dirty air’ and what can happen to children exposed to it, I believe that many of the cases of asthma can be prevented. For my honors thesis project, I read all the articles I could find pertaining to this topic, and I compiled a teaching module for elementary school children in order to educate them about the reasons behind the breathing trouble many of them face, and to arm them with knowledge that can help them prevent acute asthma attacks and further respiratory damage. My ultimate goal is to have a lesson plan published on the American Physiological Society website so that other elementary school teachers across America can have access to it and use it with their own students.

Respiratory Research

There is a very large base of information available regarding the affects of air quality on childhood asthma, and this is not surprising. It makes me very hopeful that so many researchers are concerned with the children of this generation, as they are our future. One very interesting and somewhat unique study was conducted in Australia and New Zealand, and focused on the correlation between air pollution and hospital admissions of children (Barnett, Williams, Schwartz, Neller, and Best 1272-78). What Barnett et al. found is that there is a strong correlation between short-term childhood hospital admissions and outdoor air quality (specifically, levels of NO_2). Furthermore, these increases in hospital admissions seemed to be independent of temperature. More specifically, an article written by Mattias Wjst et al (Wjst, Reitmeir, Dold, Wulff, and Nicolai 596-600) described a cross sectional study in which a correlation was found between road traffic (a primary cause of air pollution) and decreased respiratory function of German children ten years of age, living in Munich. From these articles, it is safe to assume that something as simple as keeping a watchful eye in the newspaper for the air quality ratings each day can be helpful in minimizing respiratory damage due to city pollution. Potentially moving to a less populated area to escape the high levels of NO2 and carbon monoxide that generally accompany large cities could also be helpful in extreme cases.

I came across another intriguing study titled “The Burden of Environmental Tobacco Smoke Exposure on the Respiratory Health of Children” (Gergen, Fowler, Maurer, Davis, and Overpeck 1-6). While the study showed no significant increase in respiratory infection of children exposed to environmental tobacco smoke, there was a significant increase in the prevalence (but not severity) of asthma among those children exposed to smoke during childhood. This leads me to believe that there is an environmental trigger for the development of

asthma during childhood. There are measures that should be taken, such as reducing environmental tobacco smoke, to decrease the risk of these children developing asthma.

Another article (Cook, and Strachan 1081-94) tested a similar hypothesis. They also came up with similar data, and came to the same conclusion. The paper states "We have found a clear relationship between parental smoking and the prevalence of asthma and respiratory symptoms in school children which is very unlikely to be due to chance alone" (Cook, and Strachan 1088). They did not only measure asthma in this study, but also the prevalence of wheezing, coughing, and phlegm, those being the 'respiratory symptoms' mentioned above. It is disheartening that parental smoking can cause so many uncomfortable symptoms in their children, and many of them likely don't even realize what their bad habit is doing to the well being of their children. I am hoping that by educating students, I can indirectly affect the habits of their parents in order to improve the quality of air that these students are breathing at home.

Another respiratory irritant that may contribute to increased occurrences of respiratory disorder is household mold. A study conducted by Robert E. Dales et al. measured "the association between the occurrence of molds and dampness in the indoor environment with the prevalence of nonspecific respiratory symptoms in young children." (Dales, Zwanenburg, Burnett, and Franklin 196). Not surprisingly, they found a positive correlation between increased mold and increased respiratory symptoms in Canadian children. However, these results need to be further investigated, as the primary method for data collection was a questionnaire, which may or may not have been biased in some ways.

Luckily, there was another study performed by Mahmoud Zureik et al. pertaining to airborne molds and their affect on severity of asthma (Zureik, Neukirch, Leynaert, Liard, and Bousquet 1-7). This article focused on the occurrences where pre-exisiting asthma was

exacerbated by increased exposure to mold, leading to hospital admissions and sometimes death. They found a startling statistic which suggested that when concentrations of airborne mold spores were highest, there was an increased number of asthma related deaths compared to instances of increased pollen or other pollutants (Zureik, Neukirch, Leynaert, Liard, and Bousquet 1). A similar study measuring airborne mold spores showed a correlation in children as young as 1 year old (Gent, Ren, Belanger, Triche, and Bracken 781-86). This is reason enough to adamantly encourage families with children suffering from asthma to be especially aware and cautious of mold in and around their home.

Additionally, there has been significant research relating to dist mites and cockroaches and the affects that these organisms have on asthma and respiratory symptoms. A study by David L. Rosenstreich et al. concluded that cockroach allergen, an allergen often found in bedrooms of inner city children living in impoverished neighborhoods, was correlated with increased doctors visits and hospitalizations related to asthma attacks. Interestingly, this study did not find similar correlations with dust mite allergens and cat dander. Only asthma patients with increased allergy to cockroach allergens had higher instances of sickness due to allergic reactions and acute asthma attacks. This suggests that cockroach allergen has a greater tendency to produce asthma related symptoms than any of the other household allergens they tested, even in cases where the patient had equally high allergies to all the allergens in question (Rosenstreich, Eggleston, Kattan, Baker, and Slavin 1356-63). Another study tested a possible solution to this problem. Andrew B. Murray et al. provided one group of children suffering from asthma with all the necessities for making their bedroom “dust free”, and used another group as the control (Murray, and Ferguson 418-22). In the altered bedrooms, the children showed decreased bronchial irritability compared to those in the control group as well as decreased

frequency and intensity of symptoms. This article's findings show that there are ways in which children who already have asthma can reduce their discomfort by taking simple steps to keep dust to a minimum. This is another very powerful tool that I utilized as an educator to positively influence the lives and well-being of the students that I taught in the classroom.

I believe that education is the strongest tool we have to prevent asthma in children and to reduce symptoms in children already diagnosed with asthma. There is an article written by Sonalde Desai that outlines the possible causal relationship between maternal education and child health (Desai, and Alva 71-81), but I believe that this causal relationship can flow in both directions. While it is proven that parental education levels affect the health of their children, I also believe that child education can positively influence not only the health of the child, but also positively influence the health of the child's family. Education is a powerful tool, and I hope I have educated students and empowered them to apply their new knowledge to make their homes cleaner, safer, and healthier places to live.

Teaching Module

Audience:

3^{rd}-5^{th} grade elementary classes (can be adapted for other age ranges)

Concept:

Students will learn about the function of their lungs and important respiratory health practices.

Specifics:

Students will understand how the diaphragm works in coordination with the lungs to bring oxygen into the body.

They will discuss function of the lungs, what your body needs so that it can work to maximum capacity, and what students can do at home to improve the quality of the air they breathe.

Materials:

1. Two large plastic jars of equal size and shape, one opaque and the other clear. Loosely crumple several sheets of printer paper and put them in the clear jar until it is satisfactorily filled.
2. Models of lungs made of cut off soda bottles: A balloon (simulating the lungs) is inserted, pulled over the top lip of the bottle, and hangs inside each bottle. A latex glove (simulating the diaphragm) is tied and then taped over and onto the open bottom of the bottle (see figure 3). An airtight compartment then exists inside the bottle. As the stretchy diaphragm moves up and down, the lungs inflate and deflate (simulating breathing).
    - Four or five “healthy” lungs (full size balloon)

- Four or five “unhealthy” lungs (smaller balloon)
- Four or five “restricted” lungs, simulating asthma (with a restriction –a ¼” straw threaded over the opening of the balloon)

4. Large flashcards with the following terms used in the discussion:
    - CO_2
    - O_2
    - Other chemical compounds found in cigarettes
    - Dander
    - Pollen
    - etc.
5. Whiteboard or chalkboard
6. An anatomical bust or torso if available

PROCEDURE:

1. **Why do we need to breathe?** *While probing for answers, pass out the flashcards.*
    - When you run, how does your breathing change? Why?
    - When you’re sleeping, how does your breathing change?
    - We need oxygen! **Oxygen, hold up your sign!**
    - What do we breathe out? **CO2, hold up your sign!**
    - *Draw **schematic on board** of lung next to a capillary. (see figure 1)*

2. **Gas exchange** is when the nutrients from in the air cross the barrier into the blood and then the circulatory system carries these nutrients to the rest of the body. It also brings the things we don't need back to the lungs so that we can breathe it out.
    - How does this relate back to **surface area**?
    - Air needs to be in contact with a lot of surface area in order to exchange gasses.
    - *Draw a second schematic diagram illustrating the difference between the original drawing and one in which there are many small bubbles (see figure 2)*
    - The lungs are not hollow, they have many small compartments for air called alveoli
    - Who has the **oxygen flashcard**? Hold it up! Who has the **CO2 flashcard**? Come bring them up and put them on the board

3. **Surface area**: What is surface area?
    - When you are really **hot**, what do you do? Lie spread out on the floor.
    - Why? To let more heat escape. When you spread out your body, there is a greater surface area and the heat can leave more quickly.
    - What about when you're **cold**? You shrink up and decrease surface area to retain heat.

4. Hold up **covered jar**.
    - Pretend that this is a lobe of one of your lungs.
    - Does this have enough surface area to get enough gas exchange? What if we could look inside? *Take out clear jar filled with paper.*

- How about now? Someone come up and remove the paper from the jar. Is more paper better? What does it do? We can get more gas exchange! More places where the air is in contact with the paper (capillaries/blood vessels)
- If we were to guess how much surface area our lungs have, what would you guess?
- A TENNIS COURT's worth!

5. **How do lungs work?**
    - How do we get the air into our lungs? It's not magic.
    - *Instructor holds up bottle lung model.*
    - What do you think the balloon signifies? (lungs)
    - What is the rubber glove supposed to be? (diaphragm)
    - *Instructor pulls on diaphragm and balloon deflates/inflates.*
    - What is happening? *Instructor talks about pressure inside and how lungs work. Ask student to come up and try it, holding bottle high so other students can see.*
    - *Instructor briefly explains function of diaphragm* ***and asks students to stand up*** *and breathe in deeply with their hands on their bellies, imagining their diaphragms moving and lungs expanding.*
    - Why did your belly go out? Because your diaphragm is pushing all your insides down to make room for air!

6. **First, we will focus on healthy lungs**.
    - Athletes need lots of oxygen; swimmers in particular need to hold their breath for long periods of time.

- Let's see how long we can keep a sound going. Lets all try hissing together.
- **Stand up** - Sit down as you run out of breath. Who will run out last? (Instructor sits, too, when out of breath!)

7. **Unhealthy lungs**
    - *Instructor pulls out models with smaller balloon and passes them around, one for every four students or so.* Why is decreased lung capacity a bad thing? What can cause this? Smoking.
    - *Instructor pulls out constricted airway lung models and passes them around.* What is different about this lung model? Why is it more difficult to inflate and deflate the balloon?
    - What can cause this? **Asthma** attacks!
    - How many of you know someone who has asthma? What do they use to make it feel better? An inhaler!
    - What does an inhaler do? The medicine in the inhaler helps to release the constriction. *(Be sure to emphasize that it's the medicine in the inhaler that is doing the work, not the inhaler device itself)*
    - Or in our pink balloon model, it would be like making the straw a little bigger. Those with other **flashcards** now come forward and stand in middle of room. Using flash cards, identify what is on them. **Smoking!** *Talk about risks and how to lessen exposure. Like the blue balloon model* **(Students go back to seats.)**
    - *Instructor hold up model with constriction. – Talk about asthma and irritants* like **pollen, dust mites, bedbugs,** etc. What can you do to alleviate problem?

- *Talk about lowering risk and exposure*. Stay inside, wash sheets in hot water frequently, etc….

DISCUSSION: (This can be done in groups or as a class)

1. Prepare students to respond to your arm in the air at the end of discussion time – they should end discussion and return to their seats. You will be looking for a few good helpers then.
2. Prepare students to work in groups of four or five, trying out the different models of the lungs. They can also share stories of how they will improve their air quality at home, or how they know someone with asthma, emphysema, etc., or they have pets…
3. Students break into groups and work. Instructor walks to different groups, sparking discussions among students. At about **five minutes,** instructor asks for all to be quiet and sit down.
4. Instructor probes for questions that came up during their discussions, and answers them.
5. Ask helpers to bring lung models back to the front

CONCLUSION:

What have you learned?

- What can we do at home?
- Cigarettes. Don't smoke and ask those around you not to.
- What else can we do to eliminate irritants? Vacuum with filter. Wash sheets and bedding frequently and thoroughly in hot water.
- Remember to keep lungs healthy – so they can work like lots of paper in the jar.

- I challenge you all to tell at least one person not in this class one thing you learned about your lungs and respiratory health. Maybe you can show your family by making your own lung model at home! *Pass out instructions for how students can make their own lung model.*

Figure 1:

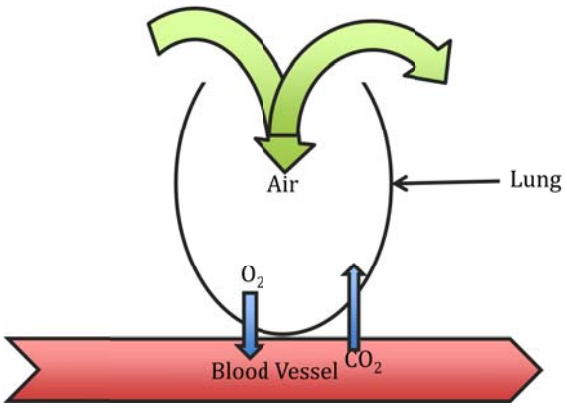


Figure 2:

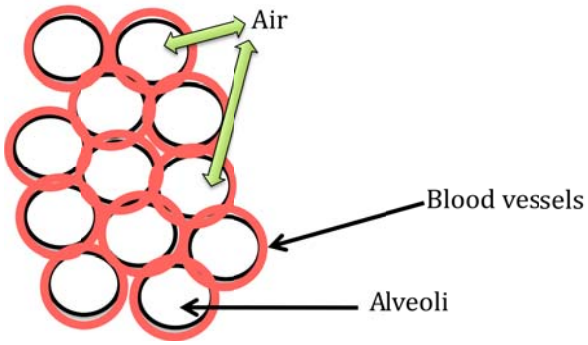
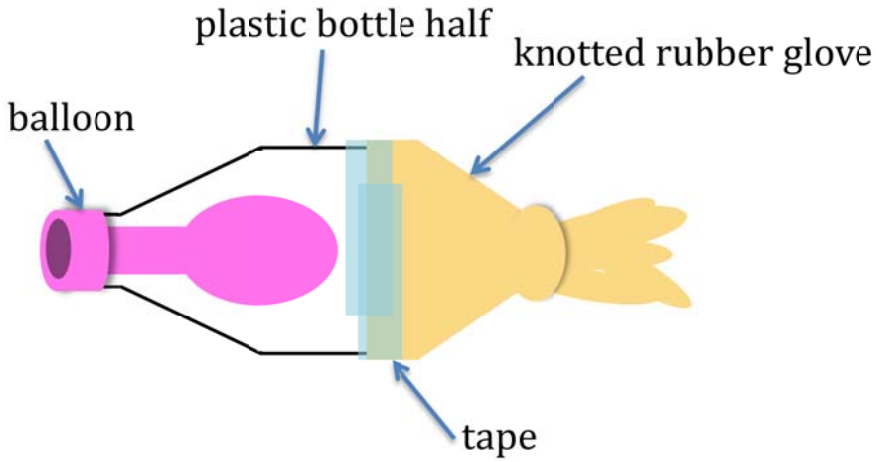


Figure 3:



Implementing the Teaching Module

I was privileged enough to have the opportunity to visit three different 4th grade classes to teach my newly created lesson plan. I wasn't sure how much the students knew about the respiratory system before I arrived to teach. I quickly learned that my lesson plan needed to be malleable and flexible to accommodate a wide variety of students and classes. I didn't end up using the 'Discussion' part of the lesson plan due to time restrictions, but aside from that omission, the lesson plan went smoothly with the students. The students had more background knowledge on the subject of respiratory health than I had anticipated, but I had plenty of information and activities to engage them despite that. I made some small changes from my original plan each time, and I felt that the more times I taught the lesson, the more smoothly it went. This was both due to my minor adjustments in the lesson, but also my own growing confidence in keeping control of 25 potentially unruly ten-year-olds. I also realized over the course of my experiences with the elementary school students that it is particularly important to leave time for the kids to ask questions, because often their questions helped me to realize that I had overlooked something essential to their general understanding of a concept. Overall I found the experience to be extremely rewarding, and I hope that the students I taught went away with new and valuable information about the importance of keeping their lungs healthy.

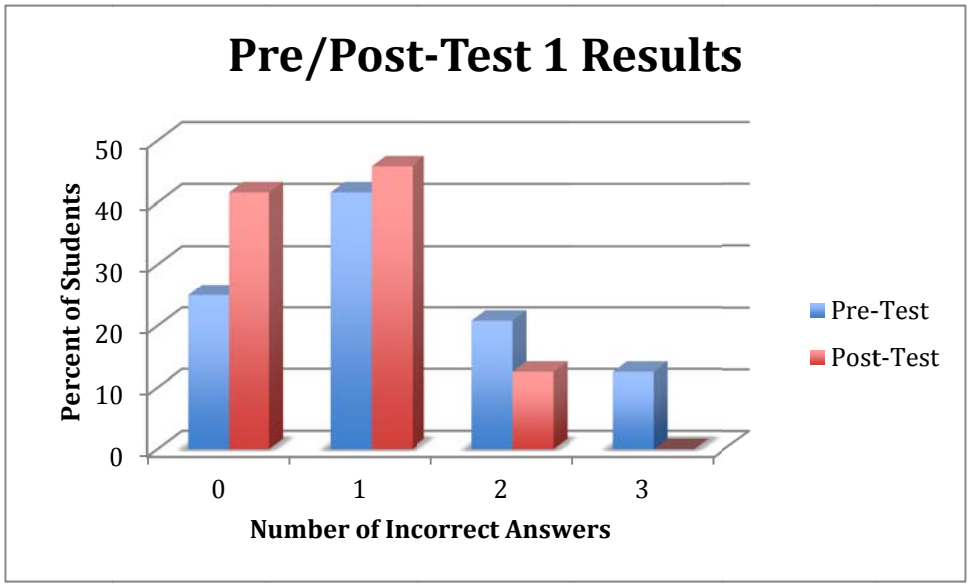
Effectiveness of the Teaching Module

In order to test the effectiveness of my teaching module more mathematically, I administered pre-/post-tests to measure their understanding of basic respiratory health concepts before and after participating in the teaching module. I started with a simple test, underestimating how much the students already knew about the respiratory system. The test is shown here:

Respiratory System Pre-/Post-Test (Version 1)

1. Where are your lungs?
    a. In your head
    b. In your chest
    c. In your legs
2. Breathing is important because it is how our bodies get oxygen
    a. True
    b. False
3. If the surface area of your lungs is smaller, less oxygen will be able to get into your blood
    a. True
    b. False
4. Do you know anyone who has asthma or uses an inhaler?
    a. Yes
    b. No
5. On a scale of 1 to 10, how dangerous is cigarette smoke?
    1 2 3 4 5 6 7 8 9 10
    not very dangerous very dangerous
6. What is a diaphragm?
    a. A muscle in your arm
    b. The name of a fish
    c. A muscle that helps you breathe
    d. Another name for lung
7. Asthma can make it more difficult to breathe
    a. True
    b. False
8. I breathe faster when I am sleeping than when I am awake
    a. True
    b. False
9. The more I move, the more oxygen my body needs
    a. True
    b. False

Unfortunately, this test proved to be too easy, and the distribution of the number of incorrect responses did not change much between the pre- and post-test because the students knew many of the answers before even giving the lesson. I only used the data from questions 1-3 and 6-9 in this analysis. The graph of this data is below.



While there is a visible shift to the left in the post-test values compared to the pretest, the average number of incorrect answers for the pre- and post-tests, 1.21 and 0.708 respectively, are not different enough to draw conclusions.

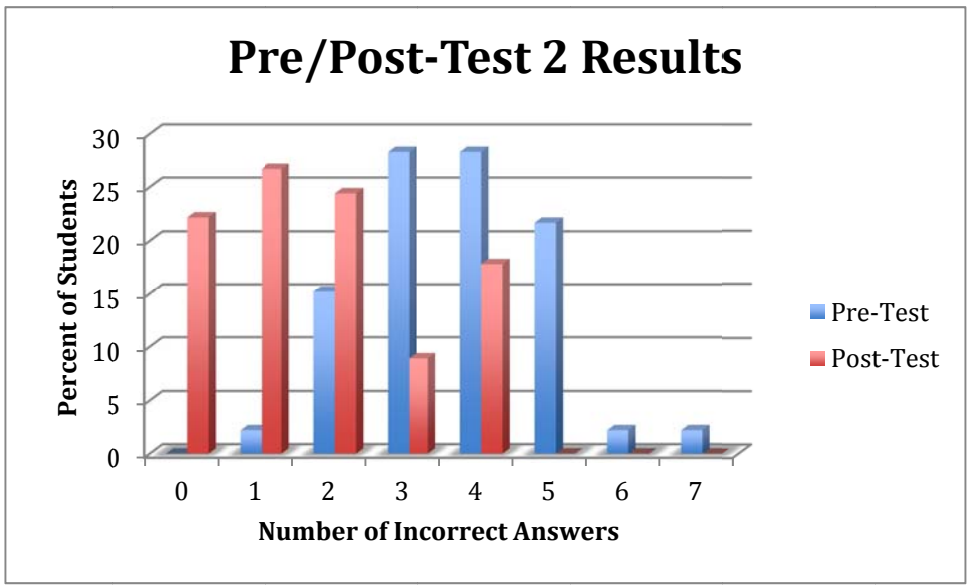
Before returning to the school the next day to teach my second class, I prepared a new test, one that had more difficult questions that were more directly related to what I would be talking about in the lesson. This new and improved test is shown here:

Respiratory System Pre-/Post-Test (Version 2)

1) Why do we breathe faster when we exercise?
    a. Because our lungs need more oxygen.
    b. Because our lungs need more carbon dioxide.
    c. Because our muscles need more oxygen.
    d. We don't breathe faster when we exercise.
2) If the surface area of your lungs is smaller, less oxygen will be able to get into your blood.
    a. True
    b. False
3) The surface area inside your lungs is about the same as
    a. The surface of the moon
    b. The surface of a table
    c. The area of a tennis court
4) Why do people with asthma need inhalers?
    a. Because the inhaler pushes air into their lungs
    b. Because there is water in the inhaler
    c. Because the medicine in the inhaler opens up the airways
5) On a scale from 1 to 10, how damaging is cigarette smoke to lungs?

    1 2 3 4 5 6 7 8 9 10
    not very damaging very damaging
6) What is a diaphragm?
    a. A muscle in your arm
    b. The name of a fish
    c. A muscle that helps you breathe
    d. Another name for lung
7) What is gas exchange?
    a. What happens when you turn on a fan
    b. The exchange of oxygen for carbon dioxide inside lungs
    c. Filling up a car with gas
    d. When you breathe in through a straw
8) The more I move, the more oxygen my body needs.
    a. True
    b. False

This version of the test, though much more challenging, provided a much nicer and more ideal distribution of scores on the pre- and post-tests. Thus, I used this test for both of the two remaining classes. I used all questions but number 5 to compile the results. The graph of these results:



As this bar chart reflects, the average number of incorrect responses on the pre- and post-tests was 3.678 and 1.734, respectively. According to these results, I would consider my lesson plan to be an effective way to teach 3rd-5th graders about respiratory health and function.

While this data does show significant increase in understanding, I also used one question on each version of the test to monitor how dangerous the students perceived smoking to be. In the first version of the exam, I asked the students to rate on a scale of 1-10 (where 10 is the most dangerous) how dangerous cigarette smoke is. In the pre-test, the average rating was 9.25. This is an encouraging value for a pre-test, suggesting that the anti-smoking campaigns are working to discourage kids from smoking. While this number is high, it still increased to 9.83 in the post-test. On the second version of the test, I asked how damaging cigarette smoke is to the lungs (1 being not damaging, 10 being very damaging). The distribution is shown in the chart below.

Danger Level	Pre-Test	Post-Test
4	2	0
5	4	0
6	1	0
7	2	1
8	4	5
9	4	6
10	27	33

Given the nature of the question and the broader distribution of responses in the pre-test as compared to the first version of the question, I think more insight can be gained. While the number of students marking 10 did not change dramatically from the pre-test to the post-test, the pre-test showed significantly more students choosing numbers below '8' than on the post-test. Despite the fact that these differences are not well displayed in the averages of the pre- and post-tests, 8.77 and 9.57 respectively (although this difference is much greater than in the first version of the question), we can infer from the chart that at least eight students changed their answer over the course of the lesson from something below 8 to something 8 or above. This is considerable. If I was able to dissuade even one of those 8 students from smoking in the future, I would consider my time with them well spent.

I have proven that even a short ½ hour lesson can change their understanding enough to possibly discourage them from ever smoking a cigarette. Based on this, I wonder why more effort isn't being put into lesson plans teaching basic physiology to elementary students. I have created an effective lesson plan simple enough to be taught in ½ hour and malleable enough to accommodate grades 2-6.

I hope I will be successful in publishing my lesson plan on the American Physiological Association website so that it can be available to primary school teachers across the country. It is remarkable that something so simple could potentially increase education to the extent of decreasing the prevalence of smoking and decreasing the frequency of asthma among children. I

believe a program implementing a lesson similar to what I have created would be a smart investment in the future this generation.

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