An Investigation into Eco-Friendly Office Supplies: Pencils and Mechanical Pencils

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Abstract

The goal of the Eco-Friendly Office Supplies SEEDS project was to investigate manufacturer's claims of "eco-friendliness" and perform a Triple Bottom Line analysis on a handful of products to determine whether purchasing the eco-friendly alternatives was worthwhile. The scope of our team's project was limited to pencils, and we chose to explore this by comparing 5 different brands of pencil, representing 4 different types of pencil: wooden, eco-friendly wooden, mechanical, and eco-friendly mechanical. By looking at environmental, social, and economic metrics, and assigning each pencil a numerical value for each metric, we were able to come up with an objective score for each pencil.

In the end, we came to the conclusion that the Staedtler Wopex, a German-manufactured eco-friendly wooden pencil, was a good eco-friendly alternative and the best overall pencil, while the ForestChoice, another type of eco-friendly pencil, did not live up to its eco-friendly claims. In the mechanical pencil category, the eco-friendly claims of the Zebra Eco Jimnie were difficult to verify, but did not offset its severely increased price point regardless of that fact.

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1.0 Introduction

Sustainability comes into play in society in a variety of forms. A very frequently used word, it has been applied to the writing utensil known as a pencil. Many of the wooden pencils or mechanical pencils bought from office supplies stores such as Staples or Grand and Toy usually end up in the garbage. Mechanical pencils specifically end up in landfills because they are made of plastic whereas wooden pencils are made of wood and can be left to decompose. As manufacturers brought their products out into the markets, some of the biggest concerns are whether or not we can continue to manufacture these pencils over a long period of time and whether or not they were good for the environment.

By manufacturing their pencils in the color green, they want to have consumers believe that the product is eco-friendly or in other words, sustainable. How sustainable their sources are is something that is a mystery to most of us. Whether they are truly more sustainable than that of a regular branded pencil, our investigation focuses on the validity of the green credentials of these pencils that are being sold at the University of British Columbia (UBC).

2.0 Investigation

The core of the investigation consisted of a Triple Bottom Line (TBL) analysis intended to compare the four different types of pencils: Traditional wooden, wooden alternatives, mechanical, and eco-friendly mechanical. In particular, we chose the following five pencils with the goal of having specific products to compare with each other:

- Staedtler Wopex Eco Friendly Pencils, HB (green-branded) - **purchased by UBC**
- ForestChoice #2 Graphite Pencils, HB (green-branded)
- Paper Mate Mirado Classic Pencils, HB - **purchased by UBC**
- Zebra Eco Jimnie Clip Mechanical Pencil, 0.5mm (green-branded) - **purchased by UBC**
- Staples Grip Mechanical Pencil, 0.5mm

The TBL analysis looked at environmental, social and economic indicators to compare the different products and attempt to answer the question of whether green-branded pencils really had environmental benefits, and if those benefits were worth the cost. Unsurprisingly, there was almost no information from the pencil manufacturers about their specific production methods and no hard data for energy and raw material consumption. This made it impossible to completely verify any green claim made by the manufacturer regarding their pencil. Nevertheless, by learning about the standard practices of the pencil industry, studying specific information where it was available, and extrapolating in cases when it wasn't, we were still able to analyze the five pencils on all 3 facets of the TBL.

The following sections (2.1, 2.2, and 2.3) list the results of our findings, with a score assigned to each metric or indicator. These scores were then tallied up in sections 3.0 and 4.0 to reach a conclusion.

2.1 Environmental Aspects

As the subject of investigation was eco-friendly office supplies, it's natural that the crux of the analysis would be the environmental aspects. The goal of the research in this section was to validate manufacturers' claims of eco-friendliness and their ability to distinguish their product from other non-green branded pencils - to separate a real effort at sustainability from "greenwashing". To this end, we used the following indicators to judge the total life-cycle environmental impact of the pencils:

- Raw materials (casing)
- Raw materials (lead)
- Production methods
- Disposal methods
- Transportation distances (carbon footprint)

Each of the five pencils listed in section 2.0 were assigned a score of 0 to 10 on these metrics. The following sections of the report will present data on all of the above metrics for both general cases, as well as the five specific pencils that are the focus of this report.

2.1.1 Raw Materials (Casing)

When it comes to the pencil casing, there are three major categories to consider: wooden, wood alternatives, and plastic. In the case of wood, the primary environmental concerns are the type of wood harvested and the method of harvesting. For instance, in 1990, pencil company Dixon/Ticonderoga was boycotted by environmental groups because of its use of tropical woods such as "teak, mahogany and jelutong" (Nguyen, 1994). Today, similarly unsustainable forestry practices continue with Dixon, Green Apple, PaperMate, and USA Gold all being listed as brands that produce wooden pencils largely through the clear-cutting of Californian forests in the Sierra Nevada mountains.

CalCedar (the makers of the ForestChoice brand), on the other hand, despite also using California wood from nearly the same geographical area in California, are certified by the Forest Steward Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC), two major organizations in the development of sustainable forestry. CalCedar's success in this area largely stems from their use of incense cedar - a wood that is sustainable due to its inherent botanical properties. First, it is not a tree that grows in groves entirely dominated by incense cedar - incense cedar "generally comprises about 5% of the trees in a stand throughout its growing range" (CalCedar). This means that it is impractical to harvest the tree by clear-cutting methods and more sustainable selective cutting methods must instead be employed. Additionally, it has a very strong natural regeneration, meaning that logged areas are quickly repopulated, with a survival rate much higher than other softwoods (Tollefson, 2008) - as such, the population and distribution of incense cedar has been stable or increasing since its first use as a pencil material in the early 20th century. As such, the ForestChoice pencil received the highest score in this category. However, the Staedtler pencil - made of a different German wood - is also PEFC certified and received the same score (Staedtler).

Although not the focus of this report, there exist green alternatives to wooden pencils made from a wide range of recycled materials such as "old newspaper, dollar bills, denim, and rubber tires" (World Watch, 2014). Thus, there exist multiple types of green wooden pencils with wildly different manufacturing processes - for example, one uses "one page of recycled newspaper rolled and wrapped around a graphite stick" (Ong, 2010). Since products like the denim and rubber pencil are rare outliers that are nearly impossible to find any data for, and we believed the paper pencils are not a realistic option due to their susceptibility to moisture, the team chose not to pursue these types of pencils in greater detail.

Finally, there are also mechanical pencils. The main raw material for the casing of nearly all these kinds of pencils (including the Zebra and the Staples-brand discussed in this paper) is plastic. In general, plastic, unlike wood, is not a renewable material and therefore mechanical pencils received a lower score than wooden pencils on this metric. The Zebra received less of a penalty for this due to its 72% post-consumer content.

2.1.2 Raw Materials (Lead)

It is a well-known fact that the "lead" in a pencil actually contains no lead and is instead primarily made of graphite. However, very few people know that the final pencil lead contains not only graphite, but also clay and a mixture of waxes (How It's Made, 2009). As nearly all pencils use the same type of lead (just manufactured in different sizes), all five products received the same score in this category.

2.1.3 Production Methods

This metric takes into account a variety of factors that aim to determine the combined environmental impact of the production of each type of pencil.

Energy Consumption - Wooden pencils consume the same amount of energy as plastic pencils and half as much energy as paper pencils. In addition, the manufacture of pencil lead is a very energy-intensive process, as the raw graphite ore has to be baked to create graphite powder, which is later baked again several times in the manufacturing process. As such, the relative impact of casing energy consumption is lessened as the bulk of the energy required to make each pencil is actually in the graphite.

Water Consumption - According to one source, wooden pencils consume 60% as much water as plastic pencils and 10% as much as paper pencils (Berolzheimer, 2006, Environmental Impacts on Resource Inputs, para. 2).

Atmospheric Emissions - Wooden, plastic, and paper pencils all produce similar amounts of carbon dioxide, nitrogen oxide, culfer oxide, and particulate matter, but the wood pencil emits 5 to 6 times more carbon monoxide than the plastic and paper ones. The wood pencil also emits about 3 times more organic pollutants than the paper pencil, but 10 times less than the plastic pencil.

Solid Waste - While the manufacture of wooden slats generally creates more solid waste than the alternatives, this waste is typically in a form that can still be recycled - sawdust that can be sold as an independent product or manufactured into plywood.

2.1.4 Disposal Methods

This metric attempts to measure the impact of the pencil on the environment at the end of its life-cycle. For wooden and paper pencils, which need to be sharpened, the entirety of the pencil will eventually end up as shavings. Since these are small, thin slices of a biodegradable wood or paper, these are nearly ideal conditions for the pencil to leave behind zero waste, even if it ends up in a landfill. A plastic pencil, on the other hand, has a chance to be recycled, but will likely end up thrown in the garbage and end up in a landfill, or worse, make its way to the ocean and become yet another piece of plastic circling the Pacific Gyre.

2.1.5 Supply-Side Transportation

The purpose of this metric is to measure the impact of supply chain transportation on each pencil's sustainability. The ForestChoice pencil is the perfect example of why a metric such as this is important - this "eco-friendly" pencil, which does, in fact, use sustainable materials as shown in section 2.1.1, is actually manufactured in Thailand. This means that sustainable Californian wood is shipped halfway across the world for manufacture, before being shipped back to the USA for sale as a finished product (Leibenluft, 2008). As such, ForestChoice received the lowest possible score of 0 on this metric. In contrast, The PaperMate Mirado pencil (which also uses Californian wood, but is manufactured in Mexico) received a better grade, as did the Staedtler (which is manufactured in Germany entirely using German materials, but must also be shipped to North America in the end).

2.1.6 Environmental Summary

	PaperMate Mirado	Staedtler Wopex	ForestChoice #2	Staples Mechanical	Zebra Eco Jimnie
Casing Materials (10)	6	10	10	2	5
Lead Materials (5)	3	3	3	3	3
Production Methods (10)	8	8	8	2	2
Disposal Methods (10)	10	10	10	2	2
Supply-side Transportation (10)	6	6	0	6	6
Total Environmental Score (45)	**33**	**37**	**31**	**15**	**18**

2.2 Social Aspects

When it comes to the social aspects of the issue of eco-friendly pencils, there are several important issues we had to consider.. First, it was important to note how transparent different companies were with regards to their information on sustainability, and how easily an average person could find this information. Second, it was important to understand the point of view of pencils' end user - what (if any) health impacts they would experience, their writing habits, as well as the issue of promoting the use of "green" pencils. Finally, understanding worker conditions was important. The following sections address the points listed above.

2.2.1 Manufacturer Transparency and Availability of Information on Wooden pencils

Largely, when it comes to standard wooden pencils, there is a dearth of information on their environmental impacts or manufacturing processes. As expected, companies trying to manufacture pencils at the bottom dollar are usually not willing to disclose much of anything - the product page for the PaperMate Mirado pencils, for example, simply lists them as "general-purpose, hexagonal-shaped yellow woodcase pencils with eraser tops" (Staples), but does not disclose anything about the raw materials or location of manufacture.

For the Staedtler Wopex, some information about this pencil is accessible and can be found easily just by searching for the pencil's model number. For example, searching "WOPEX 182 Staples" on Google will return the fact that the WOPEX Environmentally-Friendly Pencil is made of "natural fibre WOPEX material"(Staedtler). Information about their manufacturing process is available on STAEDTLER's website; however, it is not detailed and does not contain much information about the materials used in the process.

When it comes to pencils trying to market themselves in the "eco-friendly" niche, manufacturers, naturally, are more willing display this type of information on their website. For example, CalCedar brands, such as ForestChoice and GoldenBear, claim to be be manufactured from California-grown Incense Cedar, and proudly boast their Forest Steward Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC) certifications (CalCedar). Likewise, any retailer listing these types of pencils will also refer to these forestry organizations as proof of the products' "greenness". The fact that these pencils are manufactured in the USA is also easily available.

2.2.2 Manufacturer Transparency and Availability of Information on Mechanical Pencils

The Zebra Jimnie Clip Eco Mechanical Pencil is also another eco-friendly pencil that is offered at Staples. For the Zebra Jimnie Clip Eco Mechanical Pencil, the only information available is that it is "made with a high percentage of recycled material"(Staples). However, it doesn't provide any sort of process that was taken to produce the product. Staples only offers this product online, therefore, this product needs to be ordered online and then picked up in store. From it's long process, it makes it less accessible, require more effort, and more expensive for the average consumer to buy.

Regular mechanical pencils are "made through an automated process in assembly factories" (Francois, 2014). Due to the fact that it is an automated process, the impact on the worker's health is reduced. Although mechanical pencils save on the wood that is used to produce wooden pencils, previously, instances of low-level lead poisoning occurred in the United States in the 1970's. Although there was no lead contained in the "lead", but the pencil lacquer coat was found to contain high levels of lead (Pencils, 1972). However, that is not the case anymore. As mechanical pencils are very commonplace, information about them is widely available and can be found with ease whereas information on eco-friendly mechanical pencils is very difficult to find as manufacturers are unlikely to reveal their trade secrets.

2.2.3 Promoting the usage of Eco-friendly office supplies

A few ways that may promote the use of eco-friendly office supplies can be found in the comfort of using the pencils, the accessibility of the eco-friendly office supplies and the pricing of these pencils.

First, if the pencils that are being sold are not very comfortable or do not look very comfortable, then consumers are not going to purchase the pencils.. Also, by cutting down on the cheaply made non eco-friendly pencils, it would give consumers less variety to choose from, but would allow them a chance to try out a new type of pencil. Second, since the Zebra pencils are not available in-store unless it was ordered online and then shipped, it makes it hard for consumers to find them and it cuts down on the number of potential customers. All that is needed to rectify this situation is a small physical stock.

However, in the end, the most important factor in people's choice of pencils is personal preference. Some people prefer wooden pencils and some prefer mechanical, and in the absence of strong societal pressure, people's preferences are unlikely to change. For this reason, regardless of which pencil is numerically superior in the TBL in the end, it is likely that UBC will have to stock both wooden and mechanical pencils in order to suit people's preferences.

2.2.4 Worker Safety

The final social aspect of the analysis is the issue of worker safety. Some pencils are manufactured in first-world countries in relatively safe conditions controlled by some sort of government organization, such as Staedtler in Germany under strict EU regulations. Others, such as the "eco-friendly" ForestChoice, are manufactured in Thailand, a country where worker health is a much smaller concern. With one of the world's largest graphite producers - Sri Lanka - being nearby (Saint Jean Carbon), it's also natural to assume that many workers working in unsafe graphite mines are ultimately contributing to the production of the ForestChoice pencil.

2.2.5 Social Summary

	PaperMate Mirado	Staedtler Wopex	ForestChoice #2	Staples Mechanical	Zebra Eco Jimnie
Transparency (5)	1	3	5	1	0
Worker Safety (10)	6	10	2	6	6
Total Social Score (15)	**7**	**13**	**7**	**7**	**6**

2.3 Economic Aspects

The economic indicators that we felt applied strongly to pencils were:

- market cost/cost to consumer
- opportunity cost of producing pencils
- pencil life/how long can the pencil write

2.3.1 The market cost of these 5 pencils

Pencil	Staedtler Wopex	ForestChoice #2 Graphite	Paper Mate Mirado Classic*	Zebra Eco Jimnie Clip Mechanical	Staples Grip Mechanical Pencil
Price of 1 pencil (to nearest cent)	$0.40	$0.30	$0.37	$2.29	$0.60
Pack size	10 pack	12 pack	12 pack	Individual	12 pack
Vendor	Staples (Staedtler® Wopex Pencils, 2014)	pencils.com (ForestChoice #2, 2014)	Amazon (Paper Mate Mirado Classic Medium Soft Lead Pencils, 2014)	Staples (Zebra® Jimnie® Clip Eco Mechanical Pencil, 2014)	Staples (Staples® Grip Mechanical Pencil, 2014)

*The Mirado Classic is no longer available through the Staples everyday consumer store, it is still available for business customers through Staples' EWAY online store at undisclosed prices.

The most surprising result from direct cost analysis was that the ForestChoice #2 Graphite wooden, green-branded pencil is cheaper than its non-green alternative, the Paper Mate Mirado Classic. A green-branded, wooden pencil with it's sustainable credentials verified by an independent third-party is actually priced lower than pencils that make no claims of sustainability or even fair trade. On the other hand, the green-branded Zebra Eco Jimnie Clip Mechanical is almost 4 times more costlier than the non-green branded Staples Grip Mechanical Pencil.

2.3.2 Opportunity cost of producing pencils

The opportunity cost is the "next-best-alternative" use of the resource that is no longer possible (Henderson, 2008). An additional way to account for the economic costs involved in the manufacture of these pencils is to look at alternatives uses that their raw materials and labour could have been put to.

In North America, the cedar wood used for pencil casings could have otherwise been used for (but not limited to) creating furniture (Conners, 2002), toys("Mattel Ever After High Cedar Wood Doll", 2014) and building floorings ("Cedar Wood Flooring", 2014). In this case it is irrelevant whether the wood as extracted sustainably or not, since we are only looking at alternative consumers of that wood. Due to the lack of official statistics on wood use in pencil manufacture, it is difficult to assign an exact monetary value to the total reduction of output of alternative consumers of wood due to competition by the pencil industry for the same raw material (cedar). Nevertheless, we can assume that demand from the pencil industry contributed to upward pressure on the price of cedar. An increase in price of cedar would lead to higher costs faced by these alternative industries, and a possible reduction in output.

Manufacture of wooden pencils also requires the use of paraffin wax and polyethylene glycol (U.S Patent No. 2907684) to "obtain uniform color and improve the machining and sharpening characteristics of the wood for future processing" (Pencil Making Today: 10 Steps to the Perfect Pencil, 2014). Paraffin wax is also used intensively by the candles, textiles, cosmetics and pharmaceuticals industries (Uses of Paraffin Wax, 2010). Polyethylene glycol (PEG) is used everywhere from agriculture and ceramics to paper and soap products (CARBOWAX Polyethylene Glycols, 2011).

Thus, it can be seen that paraffin wax and PEG play an important role in modern society and that manufacturing pencils is one of the less vital uses for these chemicals. These chemicals are also both extracted from petroleum, a non-renewable and unsustainable resource ("Paraffin wax", 2008; Suzuki, 2014). Using petroleum indirectly as an ingredient for wooden pencil manufacture contributes to the already increasing demand and prices for crude oil, a chemical that has found ses in almost every corner of modern society.

While the manufacture of wooden pencils indirectly makes use of petroleum, the manufacture of mechanical pencil casings relies on petroleum to an even greater extent. The casing for mechanical pencils is exclusively plastics - that are created using crude oil (Sources of

Plastics, 2014). As a consequence, mechanical pencils contribute much more to crude oil demand and prices than wooden pencils.

2.3.3 Pencil lifetime

Our third economic indicator for pencils was how long the pencil would last. Wooden pencils need to be replaced once they have become too short to hold - either by sharpening or accidental snapping. Meanwhile mechanical pencils do not need sharpening and can be refilled for a long time, but are also susceptible to being snapped.

Since all 3 wooden pencils are rated to be of the same hardness and darkness in colour (the HB), we can expect them to write approximately equal lengths. Furthermore, the solid wooden casing of the pencil should protect the pencil from physical damage.

For mechanical pencils, the length that can be written by the mechanical pencil is solely dependent on the lead refill used - and not the pencil itself. Instead, the total usable life of the pencil depends mainly on the build quality of the pencil, and the personal habits of the person using it. Someone who can keep the same mechanical pencil for 5 years will not only get very good economic value out of it, but will also benefit the environment greatly by keeping the same product instead of constantly buying new ones. On the other hand, someone who has the tendency to lose their pencil every week is more likely to be suited by a cheap wooden pencil.

(More points is better)	PaperMate Mirado	Staedtler Wopex	ForestChoice #2	Staples Mechanical	Zebra Eco Jimnie
Market cost (20)	16	15	20	10	5
Opportunity cost of producing pencils (5)	3	3	3	2	2
Pencil life (15)	5	5	5	15	15
Total Economic Score (40)	24	23	28	27	22

3.0 Triple Bottom Line (TBL) Analysis

For the triple bottom line analysis, we combined the environmental, social, and economic scores into one to get a final total score for each pencil. To summarize, the indicators used were:

- Environmental
- Casing Materials
- Lead Materials
- Production Methods
- Disposal Methods
- Supply-side transportation
- Social
- Worker Safety
- Manufacturer Transparency
- Economic
- Cost

	PaperMate Mirado	Staedtler Wopex	ForestChoice	Staples Mechanical	Zebra Eco Jimnie
Casing Materials (10)	6	10	10	2	5
Lead Materials (5)	3	3	3	3	3
Production Methods (10)	8	8	8	2	2
Disposal Methods (10)	10	10	10	2	2

Supply-side Transportation (10)	6	6	0	6	6
Total Environmental Score (45)	**33**	**37**	**31**	**15**	**18**
Transparency (5)	1	3	5	1	0
Worker Safety (10)	6	10	2	6	6
Total Social Score (15)	**7**	**13**	**7**	**7**	**6**
Market Cost (20)	16	15	20	10	5
Opportunity Cost (5)	3	3	3	2	2
Pencil Life (15)	5	5	5	15	15
Total Economic Score (40)	**24**	**23**	**28**	**27**	**22**
TOTAL SCORE (100)	**66**	**75**	**68**	**51**	**48**

3.1 Recommendations

In the end, the overall winner turned out to be the Staedtler Wopex eco-friendly pencil, due to its high Social and Environmental score and average Economic score, representing its PEFC certification, sustainable German manufacturing, and reasonable price when compared to the other pencils in this group in packs of 12. The standard Staples-brand mechanical pencil, however, beat out the eco-friendly Zebra mechanical pencil - mainly since the small improvements to the Zebra's environmental score achieved by replacing some plastic with post-consumer plastic did not make enough of a difference to warrant a nearly 4x price increase. Overall, our recommendation to UBC for eco-friendly office supplies would be to continue purchasing the Staedtler Wopex to satisfy people who prefer wooden pencils, and to look for a cheaper eco-friendly mechanical alternative to satisfy people who prefer mechanical pencils.

4.0 Conclusion

In summation, we used the TBL analysis tool to compare 5 different brands of pencil, representing 4 different types of pencil (wooden, eco-friendly wooden, mechanical, and eco-friendly mechanical) and came to the conclusion that the Staedtler Wopex, a German-manufactured eco-friendly wooden pencil, lived up to its claims of sustainability and was priced similarly enough to its competitors to make it a legitimate alternative. However, the ForestChoice, another type of eco-friendly pencil, did not meet its eco-friendly claims and, ironically, only avoided last place in the wooden pencil category by being cheaper than its competitors. Although CalCedar, the manufacturer of ForestChoice, was right to promote incense cedar as a sustainable material, the fact that the sustainable Californian wood was then shipped to Thailand for manufacturing in third-world conditions before being shipped back to the USA for sale ultimately relegated ForestChoice's claims to the category of "greenwashing". In the mechanical pencil category, the eco-friendly claims of the Zebra Eco Jimnie were nearly impossible to verify, but even assuming that they were correct still did not justify the pencil's severely increased price point.

List of References

Berolzheimer, C. (2006). *Pencils: An Environmental Profile*. Retrieved from

http://timberlines.blogspot.ca/2006/01/pencils-environmental-profile.html

CalCedar. (n.d.). *About Incense Cedar.* Retrieved from

http://calcedar.com/about-incense-cedar/

CARBOWAX (2011, October 1). *CARBOWAX™ Polyethylene Glycols.* Retrieved from http://msdssearch.dow.com/PublishedLiteratureDOWCOM/dh_0865/0901b8038086527b.pdf?filepath=polyglycols/pdfs/noreg/118-01789.pdf&fromPage=GetDoc

Cedar Wood Flooring. (2014, January 1). *Cedar Wood Flooring* . Retrieved from http://www.advantagelumber.com/flooring/cedar-wood-flooring.html

Conners, T. (2002). *Products made from Wood.* Retrieved November 26, 2014, from http://www.dec.ny.gov/docs/lands_forests_pdf/woodproducts.pdf

Eco Mechanical Pencil, 0.5 mm, Blue (2014, January 1). *Zebra® Jimnie® Clip Eco Mechanical Pencil, 0.5 mm, Blue.* Retrieved from http://www.staples.ca/en/Zebra-Jimnie-Clip-Eco-Mechanical-Pencil-05-mm-Blue/product_ZEB52520_2-CA_1_20001

ForestEthics. (n.d.). *Back to School Report Card.* Retrieved from

http://wewillnotbesilenced.ca/downloads/backtoschool.pdf

ForestChoice #2 (2014, January 1). *ForestChoice #2 Graphite Pencils (12 Pack).* Retrieved from http://pencils.com/product/forestchoice-2-graphite-pencils-12-pack/

Francois, C., Harris, B. (2014, November 2). *How are Mechanical Pencils Made?*. Retrieved from http://www.wisegeek.com/how-are-mechanical-pencils-made.htm

Grip Mechanical Pencil. (2014, January 1). *Staples® Grip Mechanical Pencil, 12/Pack.* Retrieved from http://www.staples.ca/en/Staples-Grip-Mechanical-Pencil-12-Pack/product_SS2008155_2-CA_1_20001

Henderson D. (2008). *Opportunity Cost." The Concise Encyclopedia of Economics.* Retrieved from http://www.econlib.org/library/Enc/OpportunityCost.html

How It's Made. (2009, Nov 17). *How It's Made Graphite Pencil Leads* [video file]. Retrieved from https://www.youtube.com/watch?v=zkP3i1MQJWA

Juletong (n.d.). *Jelutong.* Retrieved from http://www.wood-database.com/lumber-identification/hardwoods/jelutong/

Kayne, R., Wynn, L. (2014, November 20). *What is a Mechanical Pencil.* Retrieved from http://www.wisegeek.org/what-is-a-mechanical-pencil.htm

Leibenluft, J. (2008). *Eco-Pencils.* Retrieved from http://www.slate.com/articles/health_and_science/the_green_lantern/2008/09/ecopencils.html

Mattel Ever After High Cedar Wood Doll. (2014, July 3). *Mattel Ever After High Cedar Wood Doll.* Retrieved November 27, 2014, from http://www.amazon.ca/Mattel-Ever-After-High-Cedar/dp/B00IQ8MYFM

Nguyen, L. (1994, March 18). *Students Won't Write Off Rain Forest*. Retrieved from

http://articles.baltimoresun.com/1994-03-18/news/1994077115_1_ticonderoga-pencils-dixon-ticonderoga-rain

Paper Mate. (2014). *Paper Mate Recycled.*. Retrieved from http://www.papermate.com/pages/recycled

Paper Mate Mirado (2014, January 1). *Paper Mate Mirado Classic Medium Soft Lead Pencils, 12 Number 2 Pencils (7073502097).* Retrieved from http://www.amazon.ca/Mirado-Classic-Medium-Pencils-7073502097/dp/B002766932

Paraffin Wax. (2010, January 1). *Uses of Paraffin Wax.* Retrieved from http://www.cepsa.com/cepsa/Products_and_Services/Base_Oils_and_Paraffins/Uses_of_Paraffin_Wax/

Pencil Making Today (2014, January 1). *Pencil Making Today: How to Make a Pencil in 10 Steps.* Retrieved from http://pencils.com/pencil-making-today/

Pencils, Paint and pottery. (1972, July 7). *Pencils, Paint, and pottery can give you lead poisoning. Life.* Retrieved from http://books.google.ca/books?id=_1QEAAAAMBAJ&printsec=frontcover#v=onepage&q&f=false

Saint Jean Carbon. (n.d.). *Sri Lankan Graphite.* Retrieved from http://www.saintjeancarbon.com/index.php/graphite/lumpvein/sri-lanka/

Singh, S. (2008, March 6). *Paraffin wax.* Retrieved from http://www.britannica.com/EBchecked/topic/442604/paraffin-wax

Sources of Plastics (2014, January 1). *Sources of Plastics.* Retrieved from http://www.design-technology.org/plastics.htm

Staedtler. (n.d.). *The pencil: STAEDTLER.* Retrieved from

http://www.staedtler.ca/en/company/tradition-and-innovation/the-pencil/

Staples. (n.d.). *Zebra® Jimnie® Clip Eco Mechanical Pencil, 0.5 mm, Black | Staples®.*

Retrieved from http://www.staples.ca/en/Zebra-Jimnie-Clip-Eco-Mechanical-Pencil-

05-mm-Black/product_ZEB52510_2-CA_1_20001

Suzuki, D. (2014, January 1). *PEG Compounds and their contaminants.* Retrieved from http://davidsuzuki.org/issues/health/science/toxics/chemicals-in-your-cosmetics---peg-compounds-and-their-contaminants/

Tollefson, Jennifer E. (2008). *Calocedrus Decurrens.* Retrieved from

http://www.fs.fed.us/database/feis/plants/tree/caldec/all.html

Wopex Pencils (2014, January 1). *Staedtler® Wopex Pencils, HB, 10/Pack.* Retrieved from http://www.staples.ca/en/Staedtler-Wopex-Pencils-HB-10-Pack/product_927501_2-CA_1_20001