

APPLICATION ID #7101 (Grade Band 6-8)

Step 1: Choose It!

TASK

Which environmental topic did your team select? How does this topic affect your local community? Explain how this topic is important or meaningful to your team.

Limit your response to 250 words.

TEAM RESPONSE:

We selected the topic of radon awareness, testing, and mitigation because our state has the highest percentage of homes (71%) in the United States over the Environmental Protection Agency (EPA) recommended mitigation level of 4 picocuries per liter (pCi/L).¹ Radon has the potential to occur at high concentrations anywhere in our state, with all 99 counties at risk.² Radon is the leading cause of lung cancer deaths among nonsmokers in the U.S.³ Radon gas comes from the natural decay of uranium present in the soil, rocks, and water.⁴ It moves through porous basement foundations and accumulates in homes. People are not aware of the radon hazard in homes.

Our city is a growing community (over 60,000) with many homes built each year. New homes under construction can easily and inexpensively have passive radon mitigation systems installed, however 96 counties in our state do not require it.⁵ Even when a mitigation system is installed, there can be failure of the system that homeowners is not aware of if they do not have an electronic radon detector in their home. Our state does not allow the sale of electronic radon detectors.⁶

Our grandparents' neighbor, diagnosed with lung cancer, created the interest in this project. No one in the family smoked. They lived in their home for 33 years. When tested, their home's radon level was 24 pCi/L. Dr. William Field, internationally known radon expert at the University states, "over 300 radon-induced lung cancer deaths occur each year in our state."⁷

CITATION:

1. *Environmental Health Sciences Research Center*. Web. 10 Mar. 2011. <http://www.ehsr.c.uiowa.edu/residential_radon.html>.
2. Appendix F: Radon Control Methods. 2009 International Residential Code, 786-788.
3. USA. Environmental Protection Agency. *A Citizen's Guide to Radon 402-K-00-006*. Washington DC, 2004. Print.
4. U.S. Geological Survey. The Geology of Radon. <<http://energy.cr.usgs.gov/radon/georadon/2.html>>
5. Hunger, Neal. "Neal Hunger, Arlington Development, Building Contractor." Personal interview. 15 Feb. 2011.
6. State of Iowa. Iowa Department of Public Health. Radon Program. *Chapter 43 minimum requirements for radon testing and analysis. Section C*.
7. Field, R. William. "R. William Field, Department of Epidemiology and Department of Occupational and Environmental Health." Personal interview. 17 Jan. 2011.

Step 2: Research It!

TASK

Describe the inquiry-based research your team did to identify the focus of your project. Include below a clearly defined problem statement that defines the issue and shows evidence of how it is a problem in your community. The problem statement should be developed using both personal observations and collected data. Be sure to include citations for researched data.

Limit your response to 800 words.

TEAM RESPONSE:

Our inquiry-based research began with questions we developed about radon. We set out to research the answers to who, what, why, when, and how questions we developed. What is radon? What do people know about radon as a hazard? Why is radon a problem? Where does radon come from? Who is affected by radon? How can radon be dealt with? When is radon a problem? Our research relied on sources including articles from journals, textbooks, Internet sources, and professional experts to gain more knowledge about radon, the existing data, and health effects. We found many different points of view and facts about radon. We identified and met with radon experts and organizations focusing on radon as cancer causing. They answered questions where we found conflicting information, provided accurate resources, and took us on field trips. Among those interviewed were: Dr. Field, appointed by President Obama to his radiation Advisory Board; Sarah Manley, radon testing specialist; Tim Hennes, senior building inspector; and Kelly Sittig, State Cancer Consortium. We researched the different types of devices used to test for radon.¹ We learned that radon is the radioactive decay product of uranium to radium to radon.² All 99 counties in our state have high levels of radon as a result of the redistribution of bedrock from the glacial till deposits.³ Most of the homeowners we talked to in our study knew very little about radon and its hazards. We learned that radon affects all people exposed to it, even at levels below the EPA action level.⁴ Radon, although naturally occurring outdoors, is a problem because it builds up to unsafe levels indoors. The problem occurs when someone is exposed to unsafe levels over a period of time. The duration time of exposure multiplied by the radon concentration equals the amount of exposure.⁵ One of the most positive sides of this issue is how to deal with radon. Current technology is relatively inexpensive and very effective. A mitigation system is easy to install and up to 99% effective. In new construction, homes can have a passive mitigation system installed for about \$300. The passive mitigation system uses a 3 inch PVC vertical vent pipe that is inserted into the sump hole that is sealed. The PVC pipe exits out through the roof. If radon is present, a fan and manometer are added converting to an active mitigation system. Negative pressure between inside and outside the home exists when the heating system turns on. The fan forces the radon out of the house. The manometer indicates a difference in pressure exists. Installing an active system to existing homes costs between \$1000 and \$3000.⁶ The use of electronic radon meters by homeowners lets them continuously monitor their levels and ensure that the radon level remains under the EPA action level of 4 pCi/L.

The problem is that five of seven homes in our state tested for radon have levels higher than the Environmental Protection Agency (EPA) recommended mitigation level of 4 picocuries per liter (pCi/L).⁷ Radon in our county is particularly high with an average of 7.5 pCi/L. Our state has the highest average level of radon in the country at 8.5 pCi/L.⁸ Current radon programs rely on voluntary testing and mitigation. Few people test for radon or install a mitigation system when needed. Even when a mitigation system is installed, there can be failure of the system that homeowners will not be aware of if they do not have an electronic radon detector in their home. Our state is one of two states (New Jersey being the other state) that do not allow the sale of electronic radon detectors.⁹ The EPA's website indicates radon is the second leading cause of lung cancer next to smoking and the number one cause of lung cancer among non-smokers. Radon kills over 21,000 people annually, seven times more than second-hand smoke. The National Safety Council indicates that radon is the third leading cause of all preventable deaths in the United States.¹⁰ Radon affects people who are exposed according to Dr. Field. The dangers come from exposure, which is time multiplied by concentration. We also learned from Dr. Field that about two-thirds of radon induced lung cancer cases are caused by radon exposure where the radon levels were below the EPA action level of 4.0 pCi/L.⁵

Radon can get into any type of building, but often becomes trapped in the basements of many residential homes. The home is the place of greatest exposure since this is where many individuals and families spend their time. Most play areas and fitness areas are in the basements of homes. Radon comes from a natural radioactive breakdown of uranium in the soil, rock, and water, and gets into the air we breathe.

CITATION:

1. Sun, Kainan, Marek Majden, R. William Field, and Daniel W. Field. "Field Comparison Study of Commercially Available Short-Term Radon Detectors." *American Journal of Public Health* Sept. 2006. Print.
2. U.S. Geological Survey. The Geology of Radon. <<http://energy.cr.usgs.gov/radon/georadon/2.html>>
3. Schumann, R.R., 1993, Geologic radon potential of the glaciated Upper Midwest, *in* Proceedings: The 1992 International Symposium on Radon and Radon Reduction Technology, vol. 2, Symposium Oral Papers, Technical Sessions VII-XII: Research Triangle Park, N.C.
4. Radon Health Effects. http://ces3.ca.uky.edu/energy/radon/health_effects.htm
5. Field, R. William. "R. William Field, Department of Epidemiology and Department of Occupational and Environmental Health." Personal interview. 17 Jan. 2011.
6. Hunger, Neal. "Neal Hunger, Arlington Development, Building Contractor." Personal interview. 15 Feb. 2011.
7. Snead, Bruce. "Bruce Snead, Kansas EPA Radon Hotline." Telephone interview. 11 Jan. 2011.
8. Iowa Department of Public Health. Iowa Radon Home Buyers and Sellers Fact Sheet <http://www.widph.state.ia.us>

/eh/common/pdf/radon/buyers_sellers_factsheet.pdf

9. Attention New Jersey and Iowa Residents: Unfortunately we are not able to sell Pro Series electronic radon detectors to New Jersey and Iowa customers because the state requires that companies selling the devices must undergo a costly and time consuming certification process. <<http://ahiatl.com/radon.aspx>>
10. "Health Risks | Radon | US EPA." *US Environmental Protection Agency*. Web. 09 Mar. 2011. <<http://www.epa.gov/radon/healthrisks.html>>.

Step 3: Plan It!

TASK

Share your team's action plan, including project steps, timeline for completion, necessary resources, and how your team planned to measure whether your potential solution is working to impact or fix the problem. Tell how all members contributed, and share any necessary modifications to the plan that were made along the way.

Limit your response to 450 words.

TEAM RESPONSE:

Our action plan focused on assessing public knowledge, testing homes, and working with legislators to craft a bill to require inclusion of passive radon mitigation systems in homes under construction and making it legal to sell electronic radon detectors in our state. Our steps included: 1) developing a questionnaire to see if certain home characteristics contributed to higher radon levels; 2) assessing homeowner knowledge about radon as we carried out the project; and 3) developing a protocol for homeowners to use as they tested their home radon level using electronic radon detectors.¹ We began testing once winter started and home heating systems were in use. We met with experts who could contribute to our developing knowledge as well as state and national policymakers.

We started with weekly meetings in August where we shared ideas and held discussions about what each of us had done and work that remained. Goals and assignments were written at weekly meetings. We e-mailed questions and ideas, posted documents on Google.docs, and met at the library to discuss our findings. As time went on, we met and emailed more often to discuss plans for data collection from questionnaires/surveys. We interviewed nationally recognized radon experts including Dr. William Field, who also became an advisor to the team. We created a questionnaire to investigate home characteristics that might affect radon levels. We created a pre and post survey to assess the homeowner's knowledge about radon. We researched information about how radon detectors worked and used 9 electronic radon detectors to measure the radon levels present in the homes.² We collected, tallied and entered the results of the questionnaires and surveys in a spreadsheet. We shared our findings through presentations to experts in the field, legislators at the Capitol, Congressman Loeb sack at an Environmental Energy Summit, and at the League of Women Voters Legislative Forum. We shared data collection as we distributed and collected the questionnaires, electronic radon detectors for home testing, and surveys. We tallied the questionnaires and surveys. We created educational posters, a fact sheet, and began a Facebook page.

The solution is to increase public awareness of the hazards of radon. This includes increasing the knowledge held by our legislators so that they would draft a bill to allow the sale of electronic radon detectors in our state and to require the installation of passive radon mitigation systems in homes that are under construction. We have made progress because HouseFile 421 was drafted by a legislator to allow the sale of electronic detectors. We will know the public awareness solution is working if our data show an increase in homeowner knowledge and homeowners install a radon mitigation system if they have high radon levels.

CITATION:

1. Pro Series3 Radon Gas Detector HS71512 Operating Instructions.
2. Rating Radon Test Kits. Digital Readout Meter. Radon First Alert Pro Series3, Consumer Reports. September 2008, 45.

Step 4: Do It!

TASK

Share how your team went about collecting data, keeping thorough and accurate records, testing their ideas and hypotheses and making systematic observations about whether or not their solution is working. Share descriptions of any written notes, data tables, sketches, photographs or video captured during the data collection step.

Limit your response to 650 words.

TEAM RESPONSE:

We selected homes based on a convenience sample of friends, family, classmates, church members, and neighbors. A testing protocol was created to ensure that every home tested in the same way.¹ The home characteristic questionnaire isolated factors that may influence radon levels in homes. These included: 1) type of basement walls; 2) presence or absence of cracks in basement floor; 3) type of drainage system; 4) year home built; 5) type of heat; and 6) presence or absence of mitigation systems. Two home characteristics correlated with higher radon levels. These included the use of non-forced air heat (36.8% higher radon concentration in lowest level of the home) and the lack of a mitigation system (85.5% of unmitigated homes had levels at or above the EPA action level). (see attachments) A post survey was administered homeowners to learn about their level of awareness before and after testing. There was a 24.8% increase in awareness. (see attachments) The survey also asked if the homeowner was considering a plan of action if the radon levels were above the EPA's action level of 4 pCi/L.

We set a goal to test 70 homes. We scheduled a time to meet each homeowner to give out the questionnaire, pre survey, and electronic radon detector. When we met we explained who we were, what we were doing, the protocol for using the electronic radon detector, and presented our consent form for them to sign. The questionnaire included a data table to record the radon levels present in their homes after 48 and 72 hours. Questionnaires were collected after 4 days. Two weeks after collecting the questionnaires we went back to the homeowners and asked them to complete a follow up survey.

In order to know which questionnaire and survey was given by each of us, we assigned the questionnaire or survey the homeowner received a number with the first letter of our name and a number. We used Microsoft Excel spreadsheet to record the data from the homeowner's questionnaire and surveys. Columns were created in the spreadsheet for each household variable on the questionnaire. Each team member entered the data from the questionnaires they handed out. One member entered the data in the master spreadsheet that contained all the data from each of the individuals and data accuracy was assured by having another person check the data entry. We developed a method to tabulate the data. Homes with specific characteristics in a survey question received a "1" in that cell for a yes, and we left "no" answers blank. This method allowed the characteristic data to be counted and summarized into tables and charts.

In a similar fashion Follow-up Survey Data was tabulated by ranking the answers one to four, where homeowners stated they knew "Nothing", two knew a "Little", and three knew a "Fair Amount", and four was "Well Informed". We then could quantitatively compare the results of the pre-test and post-test and the radon levels of mitigated and unmitigated homes. We used the thoughts people had about radon as anecdotal evidence from homeowners to support our hypothesis. Our hypothesis is if people are made aware of radon, its problems and available testing, along with installing mitigation systems, there will be an increase in testing and installation of these systems. If legislators are made aware of our state's high incidence of radon and solutions, then legislative action may be undertaken to allow the sale of electronic radon detectors and to stub in mitigation system with 3 inch PVC vertical vent pipe in homes being constructed.² The follow-up survey along with anecdotal comments showed that most people knew very little about radon or held incorrect "facts" about its harmful effects. In our presentations to 10 legislators and the newly appointed Director of State Department of Public Health (SDPH), not one knew state law prohibited the sale of electronic radon detectors.³

CITATION:

1. Pro Series3 Radon Gas Detector HS71512 Operating Instructions.
2. Appendix F: Radon Control Methods. 2009 International Residential Code. Figure AF102. Radon-Resistant Construction Details for Four Foundation Types, 789.
3. State of Iowa. Iowa Department of Public Health. Radon Program. *Chapter 43 minimum requirements for radon testing and analysis. Section C.*

Step 5: Analyze It!

TASK

How did it go? What did your team's testing reveal? Did your solution impact the problem it identified? Share what made your plan work (if appropriate); any challenges met along the way; how you overcame those challenges; and what adjustments were necessary. Would your team have done things differently if given the opportunity? If testing is still ongoing, share any results gathered so far.

Limit your response to 400 words.

TEAM RESPONSE:

The results of our project show people and legislators are taking us seriously. Our testing revealed: 1) 84.6% of homes tested in our county had very high levels of radon; 2) most people knew very little about radon and its harmful effect of causing lung cancer; 3) 76.5% of homeowners found electronic radon detectors very easy to use; 4) the Follow Up Survey indicated a 24.8% increase in awareness; 5) 5.9 % of homeowners were taking action to mitigate radon levels in their homes as a result of our project; and 6) legislators learned electronic radon detectors could not be sold in our state. The increased awareness of participants shows our plan and solution is having an impact.

We were surprised that only two home characteristics correlated with higher home radon levels. Our data shows testing does raise awareness. Not enough people know why they should test. Only 34.5% of people who participated in the project had their homes tested previously.

The major challenge we faced was convincing some people that radon is a problem. We found people that did not want their home tested. Knowing the results would weigh heavy on their minds. A second challenge was convincing legislators to allow the sale of electronic radon detectors. These would allow homeowners to see and know the concentration of radon at their convenience. The third, and most difficult, challenge is to pass legislation requiring installation of passive radon mitigation systems in new homes under construction. Passive mitigation systems only require the installation of PVC piping in homes under construction.¹ The process is easy and costs under \$300. There are 947 municipalities in our state.² Every city has jurisdiction to pass building code laws in their communities. "Home Rule" protects cities from mandated legislative action.³

The challenge is to convince the Home Builder's Association in the major cities to adopt Appendix F. Their involvement is key to having all of our state consider adopting Appendix F.

Presentations to legislators increased their awareness of the issue. Representative Kaufmann took our information and crafted a bill. If HouseFile 421 passes the House and Senate then the sale of electronic radon detectors will be allowed in our state. 76.5% of homeowners in our project stated the electronic detectors were easy to use and 58.8% said they would buy one if they were available for purchase.

CITATION:

1. Appendix F Radon Control Methods. 2009 International Residential Code. Figure AF102. Radon-Resistant Construction Details for Four Foundation Types, 789.

2 "Cities In Iowa." *Iowa League of Cities Homepage*. Web. 09 Mar. 2011. <<http://www.iowaleague.org/aboutcities/citiesiniowa.aspx>>.

3. Legislative Guide to Local Iowa Government Initiative and Referendum. Iowa Constitution Article III §§ 38A and 39A, 1978, 2-3.

Step 6: Share It!

TASK

Now it's time to spread the word! Tell us what impact your project had on the local community, and how your team's newfound knowledge can be shared with others who want to make their communities a better place to live. What other kinds of communities might benefit from the team's conclusions? Be sure to explain how much time is recommended to complete the project, and what resources and materials are required.

Limit your response to 450 words.

CITATION:

1. House file 421. A bill for an act relating to the performance of radon testing. <<http://coolice.legis.state.ia.us/Cool-ICE/default.asp?Category=billinfo&Service=Billbook&menu=false&hbill=HF421>>.

2. "Number of Counties by State." *Charleston County Government*. Web. 09 Mar. 2011. <<http://www.charlestoncounty.org/stats/bystate.htm>>.

3. Attention New Jersey and Iowa Residents: Unfortunately we are not able to sell Pro Series electronic radon detectors to New Jersey and Iowa customers because the state requires that companies selling the devices must undergo a costly and time consuming certification process. <<http://ahiatl.com/radon.aspx>>

4. Appendix F Radon Control Methods. 2009 International Residential Code. Figure

Table AF101(1). High Radon Potential (Zone 1) Counties. pg. 787-788

5. *National Association of Home Builders*. Web. 10 Mar. 2011. <<http://www.nahb.com>>.

TEAM RESPONSE:

Our project positively impacted 68 families in our community by increasing their awareness of the hazards of radon and the concentration of radon in their homes. Our impact goes beyond our community because of presentations to local, state and national legislators. Our research findings led Representative Kaufmann to draft HouseFile 421 to legalize the sale of electronic radon detectors.¹ If the bill passes, we will have impacted our entire state. But radon is a critical problem in 38 of the 50 states.² Forty-eight states allow the sale of electronic detectors.³ The challenge is in providing education and getting public involvement in the 38 states with 35% of their counties with radon levels exceeding the EPA recommended action level.⁴ We believe that students, along with adults, can use our radon brochures, present radon facts at local organizational meetings, set up poster displays in malls and businesses, and work with local Home Builders' Associations (HBA).⁵ Work with the HBA would entail exploring the adoption of Appendix F from the International Builder's Code requiring new residential construction to install passive mitigation systems.

Any community would benefit from our team's conclusion, but the communities with the greatest potential benefit are in those counties in the 38 states where it is known radon levels exceed the EPA's recommended level. The time commitment varies, depending on whether or not groups use brochures already available on radon or develop their own. The two major time commitments relate to testing (by eliciting interest in a number of ways) and presenting. When we talked with homeowners about testing, we found we should allow about 15 minutes minimum to talk about radon, invite their participation, and go over how to use the radon detector. For our testing we chose people with whom we regularly interacted. This could be done in other communities. Another option is to focus on testing during Radon Awareness Month or at times when there may be higher public interest. People could register at a mall or similar location. The Chamber of Commerce could purchase electronic detectors for community use. Libraries could have radon detectors to sign out to test homes. Electronic radon detectors are the key element for replication of our project. The real challenge is getting the interest. Because we knew the people who owned the homes where we took the detectors, it was easier. People can use our Facebook page and the website we are creating.

Presentations take time to develop. We found it effective to do a 10-15 minute presentation and then ask for questions. If students did the presentations, it would be helpful for an adult to be present in case a question was asked that needed further research.

Step 7: Attachments

TASK

- You may include attachments to provide more information.
 - Up to 5 images (.jpg, .gif, or .png) or pdf or ppt
 - [Alpha Radon Step 7.pdf](#)
 - 1 video - 1 minute or less (Videos will be reviewed for content, not the aesthetic quality of the video (.wmv, .mov, .flv))
 - No video file found.
 - Website links - up to 5 links
 - <http://energy.cr.usgs.gov/radon/midwest1.html>
 - <http://www.epa.gov/radon/pubs/citguide.html>
 - <http://www.buildingperformancegroup.com/Index/terminology.php>
 - http://www2.iccsafe.org/states/Seattle/seattle_residential/PDFs_residential/Appendix%20F.pdf
 - <http://coolice.legis.state.ia.us/Cool-ICE/default.asp?Category=billinfo&Service=Billbook&menu=false&hbill=HF421>