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Lesson Plan

Stage 1
Identify Desired Results

Catchy Title: Compare Your Air
Theme/Topic of Lesson: Statistics
Time Commitment: 2-90 minute periods
Subject Area(s):
   Mathematics - Statistics
   Mathematics - Process skills
   Science - Environmental
Grade Level(s): 6,7,8
Standards Alignment:
Class Challenge Question:

How does the air quality index in one area of the state or country compare with that in another location?

How has air quality changed over time in those two locations?

Using a best fit curve, what do you predict the air quality will be in those locations in the future?

Stage 1
Lesson Information

Stage 2
Outcomes and Standards
Objectives
Assessment

Stage 3
Resources
Materials
Vocabulary
Procedures
Day Plans
Enrichment Options

Stage 4
Teacher Reflection

Overview:

The EPA collects air quality data for different areas in the country and has been doing so for a number of years. In this lesson the students will compare the data for different locations that they select and investigate trends over the course of a number of years. This will give the students an opportunity to apply statistical measures (mean, median,mode) to data from the real world. By using data from different years, students can also detect trends and determine if Air Quality in that location is improving or getting worse. The locations can be counties or metropolitan areas. Students can choose two or more locations based on their ability and time allowed.

Before doing the air quality calculations students will develop a lunch quality index and do very similar calculations to insure they understand the concepts. Then they will be introduced to Air Quality and the air quality rating system by viewing an EPA website.

Students should be able to use the internet to gather information. They can collect data in a computer generated program, or a hand drawn one. Once the data are gathered computers are not necessary, but calculators would be helpful. Students can graph with a computer program, a graphing calculator, or by hand. It will be helpful if statistical measures and line of best fit are taught before this lesson with straightforward data sets and this used as practice and application. (If desired the lunch rating system mentioned above can be expanded for this purpose.)

Stage 2
Determine Acceptable Evidence

Knowledge of Statistics (6-8)	Maryland Content Standards Students will collect, organize, display, analyze, and interpret data to make decisions and predictions.	Maryland State Indicators **4.8.4** select and justify **mean, median, mode**, or **range of a data set** as the best representation of data. (MLO 3.5.)
Knowledge of Statistics (6-8)	Maryland Content Standards Students will collect, organize, display, analyze, and interpret data to make decisions and predictions.	Maryland State Indicators **4.8.1** *conduct and* use the results of a **statistical**

		investigation to answer a question. (MLO 3.1.)
Knowledge of Statistics (6-8)	**Maryland Content Standards** Students will collect, organize, display, analyze, and interpret data to make decisions and predictions.	**Maryland State Indicators** **4.8.5** *examine the misinterpretation of statistics* ● *identify factors leading to faulty interpretation or representation of data including choice of sample* **population**, *graphical display*, **scale**, *and use of statistical measures.*
Knowledge of Statistics (6-8)	**Maryland Content Standards** Students will collect, organize, display, analyze, and interpret data to make decisions and predictions.	**Maryland State Indicators** **4.8.3** a. analyze and interpret frequency tables, box and whisker plots, and scatter plots. (MLO 3.3.) b. make predictions about a set of linear data given the line of best fit (MLO 3.4) c. *fit a line to a set of linear data and use this line to make predictions about the data.*
Process of Problem Solving (6-8)	**Maryland Content Standards** Students will demonstrate their ability to apply a wide variety of mathematical concepts, processes, and skills to solve a broad range of problems.	**Maryland State Indicators** **7.8.1** **In order to solve problems, students will be able to:** -use information to identify and define the question(s) within a problem (MLO 5.1, SFS 2.2, SFS 2.4) -make a plan and decide what information *is needed or missing* and steps needed to solve the problem (MLO 5.2, SFS 2.4) -choose the appropriate operation(s) for a given problem situation (MLO 5.3) -*create or* select and then apply appropriate problem-solving strategies to solve a problem from visual (draw a picture, create a graph), numerical (guess and check, look for a pattern), and symbolic (write an equation) perspectives (MLO 5.4, SFS 2.4) *analyze multi-step problem-solving situations (SFS 2.4)* -organize, interpret, and use relevant information (MLO5.5, SFS 2.2, SFS 2.4) -select and use appropriate tools and technology (MLO 5.6, SFS 2.4) -*persevere through to a solution* -verify the conclusion based on the data and the processes used (SFS 2.4) -communicate the conclusion with appropriate mathematical *justification (SFS 3.2)* -show that no solution or multiple solutions may exist (MLO 5.7, SFS 3.2) -*ascribe a meaning to the solution in the context of the problem* -identify alternate ways to find a solution (MLO 5.8, SFS 2.4) -apply what was learned to a new *and/or more complex* problem (MLO 5.9, SFS 2.4)
Technology research tools (Gr. 6-8)	**ISTE Technology Standards** 5. Technology research tools ● Students use technology to locate, evaluate, and collect information from a variety of sources. ● Students use technology tools to process data and report results. ● Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.	**ISTE Technology Performance Indicators** **Select and use appropriat** Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems.

Learning Objectives:

The Students will:

● Gain a basic understanding of the air quality index rating scale.

● Gather data about the air quality index in at least 2 locations over 5 years from an EPA website

● Using the numbers of days with air quality rating of good, draw a best fit curve to show trends in air quality in each location.

● Calculate means, modes, medians of number of days that have air quality ratings of : good, moderate, unhealthy for sensitive

groups, and unhealthy over 5 years for 2 or more locations

● Make predictions about the air quality in those locations in the future and compare locations to each other.

Assessment

. 1.Data table containing relevant data in appropriate table format.

 2. Graphs of data showing best fit curves .

 3. Table containing means, modes and medians

4. Conclusions drawn from data (on worksheet provided)

Stage 3
Plan Learning Experiences

Resources

Internet Sites

EPA Data on air quality

This website provides air quality data for specific counties for specific years.

http://www.epa.gov/air/data/geosel.html

Air Quality Index Kids

Good introduction to the air quality index for kids. There is also a link for teachers with additional information, games and activities about the air quality index and air pollution.

http://www.epa.gov/airnow/aqikids/index.html

EPA Air Quality Information

This website gives background about air quality and the different measures that the EPA looks at in determining air quality

http://www.epa.gov/airnow/aqibroch/aqi.html#2

National Atlas

This website can be used to pinpoint locations about which data are gathered.

http://nationalatlas.gov/natlas/Natlasstart.asp

Materials

Per class

● Compare your Air--scoring rubric. Can be distributed to students if desired. (View)
● Compare Your Air-lunch quality index sample data--if you choose to use it. Teacher or students can create their own. (View)

as determined by instructor

● Calculators if desired.

  Graphing computer program, if desired.

  Excel or similar computer program, if desired.

● Compare Your Air--The Air Quality Index (View)

Per student team/group of 2

- computer with internet access

Per Student

- Graph paper and colored pencils if students will be making graphs by hand.

- Compare Your Air-Air Quality Index worksheet (View)
- Compare Your Air--Lunch Quality Index worksheet (View)

Vocabulary

- **mean** - an value that is intermediate between other values; an average
- **median** - the middle value in a set of statistical values that are arranged in ascending or descending order
- **mode** - the value tha has the highest frequency within a statistical range
- **line of best fit** - a straight line that best represents the data on a scatter plot

Procedures

The teacher should introduce scatter plots, lines of best fit and means, modes and medians if students are not familiar with them, giving some simple and straightforward exercises to practice them. If desired the teacher can introduce the concept of an index and have the students make a lunch quality index first. The statistical concepts can be practiced on the lunch quality index data before they begin to use the air quality index data.

The teacher will introduce the concept of air quality index. Students can complete the worksheet independently in a computer lab. It can also be done as a whole class lesson using one computer, or by providing the information from the website to the students. The students should gain a working knowledge of the material so it is apparent that the data and statistics have real world implications.

Students will then be directed to the website with the air quality data collected by the EPA.

Each team of two students should choose two or more locations (counties or metropolitan areas) . The National Atlas website can be used to see the locations of counties. The amount of guidance needed in this will depend on the students involved. This lesson is written so the whole class gathers one set of data together, and each group gathers an additional set independently.

Once locations are selected, the students will make a table of the number days the air quality index had each rating (good, moderate, unhealthy for sensitive groups, and unhealthy) over 5 years.The design of this table can be done as independently as possible, and can be done in Excel or by hand (or in another program). The table from the Lunch Quality Index can be easily modified.

Using the numbers of days the air quality index was good, students should graph the data and draw a line of best fit.They should answer related questions on the worksheet.

They will then calculate the mean, mode, and median of the numbers of days of each rating over the 5 years for each location and will answer questions on the data sheets.

. Each team should present their tables, graphs and findings to the class. They should be able to explain how they reached their conclusions.A brief discussion of the information provided by the various statistical values should occur after each presentation. After all presentations, a general discussion of the usefulness of statistics can occur and how statistics can help and can be misleading.

First Day: Quality Index
Daily Challenge Question: What information can we gain by using an index?
90 minutes

Set-up Directions:

If the teacher desires the "lunch data" for the introductory lesson can be gathered in advance. Over the course of the two weeks before the lesson is taught, you can ask the students how they would rate the lunch that day (or the previous day). In this way you can gather data and explain a rating system in an entertaining way and have the students well prepared for the lesson.

Each student or pair of students will need a computer, and each student should have a pencil and a copy of the Lunch Quality Index handout and the Air Quality Index handout.

If this is being done as a whole class , there should be a computer with a projector, or a handout of the materials from the website.

Teacher Presentation & Motivation:

The first portion of this lesson is to have the students develop their own lunch quality index. This should be done in a lighthearted way, should be fun for the students, and at the same time clarify the complexities of an index for them. It is a good opportunity to practice the statistical manipulations if necessary. The data can have been gathered in the previous few weeks, or developed at the time of the lesson. You can make up data for different schools as well (sample data is included in the lesson). The whole project can be begun from this non-threatening point of view. It has the advantage of having students practice interpretation of data, and is set up to mirror the Air Quality index worksheet. The Lunch Quality Index worksheet can be completed as a class, or by the students individually or in groups.

Once the lunch quality index worksheet is completed, ask students if they are familiar with any similar real life rating systems. Many students have heard of ozone alert days, or code red days when people with asthma are warned not to go outside. The discussion about the air quality index can be started from what the students know about this index and the topic as a whole. After students have shared what they know, send them to the website to learn the specifics of the air quality index. Have them complete the Air Quality Index worksheet.

Review the air quality information with students before going on to the next part .For students that finish quickly there are other pages to explore on the same website, as well as some games which are shown on the Teachers link.

Activity 1 - Lunch Quality Index

Students will develop a rating system for the quality of school lunches. If desired teacher can collect data from students in advance, introducing the concept of a rating system two or more weeks before the activity. There is a data sheet provided with this lesson to use if desired. The rating system used on the worksheet is --fantastic, okay, edible, awful. The worksheet can easily be modified to change these to the students' choice.

Once the data are collected and/or presented students are asked to complete a worksheet interpreting and then manipulating the whole data set over 5 months (10 days/month) and then from a different school. For each school, they are asked to plot the number of days each month the lunch was fantastic and plot a line of best fit. They are asked to calculate mean, mode and median for the number of days in each category for each school over the 5 months. They are then asked to interpret their results.

This exercise was set up to mirror the Air Quality exercise as closely as possible.

Activity 2 - Air Quality Index

Students will go to the EPA website: Air Quality Index for kids and click on " Air Pollution and Health" Click through that section, completing the worksheet If finished early, they can click on "Clean and Dirty Air" and "What is the AQI?" at the same site, or play related games as approved by the teacher.

Focus for Media Interaction
Focus for Media Interaction: The focus for media interaction is a specific task to complete and/or information to identify during or after viewing of video segments, Web sites or other multimedia elements.

The Air Quality Index worksheet will be completed while viewing the website.

Viewing Activities
What will your students be responsible for while viewing this piece of multi-media or video?

Students will be responsible for knowing the different ratings of the air quality index and what they mean.

Post Viewing Activities
How will students utilize the information they gathered while viewing the multi-media or video?

During the next activity, students will have to manipulate actual air quality data. They will need to draw conclusions from these data for which they will need to have an understanding of the rating system.

Wrap Up:

Using the worksheet, review the air quality index, and make sure that the students have a good understanding of what the different colors and ratings mean. If necessary, refer back to the lunch quality rating scheme. Review calculation of mean, median and mode. Review how to draw a line of best fit. Prepare the students to collect the data. If time allows, discuss locations for which you will be gathering data. Assign student groups to different locations or have them choose a location. Construct table to collect data.

Second Day: Data Collection

Daily Challenge Question: Collect AQI data for two locations. What conclusions can you draw about air quality in those locations?
1 90 minute period

Set-up Directions:

Each student or student group will need a computer with internet access. They will also need to construct a data table either in Excel, or a similar program, or with paper and pencil. A calculator would be useful for each group as well. If students will not graph on the computer, they will need graph paper and colored pencils.

A copy of the Compare your Air worksheet for each student is needed.

Teacher Presentation & Motivation:

This is the nitty gritty data collection. It is not difficult, but the data table can look very intimidating to a student. It is a good idea to show them what they will be looking at before they are asked to gather the data on their own. It is useful to collect at least some of the data as a class and is recommended to begin with your own location.

A review of the AQI would be helpful to begin the lesson. If the data table and location choices were not completed during the previous class period it should be completed at this time. Discuss with students what data they will collect (number of days with each level of AQI rating) what they will calculate (line of best fit for numbers of days with a good rating and means, medians,and modes of each rating, both over 5 years) and what this can tell them (an indication of the trends in the air quality and a snapshot of the quality of the air in that location over those five years). Work with them to choose other locations (or explain why you have assigned the ones you did). Are you looking at some urban and some rural counties? Areas in the east and west of the country? The National Atlas website is useful because it shows exactly where counties are located in the country.

The questions the students will be answering on the Air Quality Index worksheet ask them to use the statistics to draw conclusions similar to the ones on the Lunch Quality Index worksheet. Emphasize that this is real world data that can be applied to answering real world questions

It is important to note that not each location is measured the same number of times. Have students look at the third column in the data table (#of days with AQI) to see what the total number of days measured is. Ideally, students should choose two locations with the same (or similar) number of days measured or use percentages (good ratings as percentage of # days) to complete the exercise.

A final point to emphasize is the limitations of statistics. This can be introduced here and further developed at the end of the lesson.

Activity 1 - Data Collection

In this activity, students will collect actual data from the EPA website for air quality over the past five years. The whole class will work together to gather data for the county (or Metropolitan area) in which you are located. The data table can be overwhelming because it contains many numbers in many rows and columns, but students should focus on their location and the numbers of days the air quality index was Good, Moderate, Unhealthy for Sensitive Groups, and Unhealthy.

Once students have gathered data for the location where they live, they can plot the number of days the AQI was good each year over the five year period chosen. They should then draw a line of best fit for the data. (Before drawing a final graph, the students should have the data for the second location so the interval on the graph is appropriate such that they can put both sets of data on one graph) Students should then calculate the mean, mode and median number of days for each rating over the five years.

The students can then pick another location to use to collect data. The National Atlas website is one resource that can be used to help students select another site. Students should repeat the above procedure for the second location.

Focus for Media Interaction
Focus for Media Interaction: The focus for media interaction is a specific task to complete and/or information to identify during or after viewing of video segments, Web sites or other multimedia elements.

Prior to accessing the website students should create a data table to record their data. This can be created as a class, by the individual students or groups, or the data table from the lunch quality index worksheet can be modified for use.

Viewing Activities
What will your students be responsible for while viewing this piece of multi-media or video?

Students will go the the EPA Air Quality Information Website.

Click on state where your location is. Click go.

Note: Data is given by county or metropolitan area. Clicking on more than one state, gives a larger table, but the data is broken down the same way. One state at a time is plenty!

Look for Monitoring, underneath which is written Reports. The first report listed is Air Quality Index. Click on that.

Select year, and Summary Type (county or metropolitan statistical area). Click on Generate Report. You can select the current year, but you will not have a complete data set to compare with previous years!

Enter data for the location and year into the appropriate place on the data table, entering number (or percentage) of days when air quality was good, moderate, unhealthy for sensitive groups, and unhealthy.

Repeat until data table is complete for five years.

Repeat for the second location.

Post Viewing Activities
How will students utilize the information they gathered while viewing the multi-media or video?

This activity is presented on the Air Quality Index Worksheet.

Using the number of days when the air quality was good, have students graph (using a scatter plot) the values over five years. If students are capable they can graph other ratings, using different colors or symbols to differentiate among ratings and between locations.

Have the students draw a line of best fit on their scatter plot and complete Air Quality Index Worksheet through question 4.

Calculate the mean, mode and median for number of days of each AQI rating over the years they have recorded the data .

Answer questions 5-7 on the Compare your Air Worksheet.

Wrap Up:

Have students present their data to the class. Ideally they can all put their data on a shared data table (in Excel possibly) and graph their data on a common graph.

Review the questions on the sheet and discuss the results. Are there any trends obvious? In general is air quality improving?

Ask the students about the limitations they see with the statistics...the graphs only show good days, they tell us nothing about what is happening in the other categories (good may be increasing, but so might bad and moderate is decreasing!) The mean just gives a glimpse, but says nothing about a really bad year, etc.

Return to the usefulness of statistics...they have their shortcomings, but a huge table with many numbers is of little use and so statistics allow us to make some sense in a concise way and evaluate and make decisions.

Enrichment Options

Community Connection

What is the air quality index in your community?Keep a running chart.

Tally up information at the end of the year.Combine with temperature data to see if there is a correlation.

Parent-Home Connection

Does anyone in your home suffer from air-related problems (asthma, etc.)?

How do they react when air quality is poor?

Cross-Curricular Extensions

Learn more about air quality and pollution in science.

Write a letter to polluters in your area for Language Arts.

Connect the choice of locations to a social studies/geography lesson.

Stage 4
Teacher Reflection

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