

The Crumb Rubber Debate



Sometimes making decisions that are best for the environment and for human health can be complicated. Often, scientific evidence, opinion, and anecdotal reports get mixed together in batches that are difficult to separate. In this activity, you will research and debate the use of crumb rubber as artificial turf infill for a particular field based on the evidence while weighing multiple factors and considering the trade-offs.



GRADES
9-12



NEXT GENERATION SCIENCE STANDARDS

- Science and Engineering Practices: Asking Questions and Defining Problems
- Science and Engineering Practices: Engaging in Argument from Evidence
- Crosscutting Concepts: Cause and Effect: Mechanism and Prediction
- Disciplinary Core Ideas: ETS1: Engineering Design
- Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems



PREPARE:

Time Required: 3 class periods (135 minutes), with additional time for research



MOTIVATE:

- Show example headline(s) of the crumb rubber controversy found in the teacher tips section and ask students what they think might be happening here.
- Show picture(s) of crumb rubber and ask students if they know where it comes from (see teacher tips section).
- Discuss the idea of the controversy around crumb rubber.
- Discuss the following questions with students: What can citizens do to make informed decisions to resolve disputes about issues that relate to the environment and human health? How do we find out the real science behind controversial issues and how do we communicate that information to others?



Part 1: Case Study

- Have students read the Anytown Soccer Field Re-turfing Project case study
- Conduct the activity according to the directions on the activity page. You may need to spend a little extra time discussing the terms “constraints” and “considerations” (see teacher tips for guidance).
- Distribute the Decision Matrix and provide a general overview for students. In the next few steps, you will provide more detailed guidance in the use of this matrix.
- Distribute the Crumb Rubber Resource handout. The links on this page will provide a starting point for students to understand the problem, obtain information about the different factors they need to consider, and analyze the evidence from research papers.
- Some factors that students might consider include price, life span, g-max rating, toxicity, density of the infill project, and appropriateness for use in a flood plain.
- Discuss how to determine the relative importance, or weight, of each category, and how to score each option. This provides a visual and numeric way to see how the choices compare across multiple factors (see teacher tips for guidance).
- Using sample matrix of What Should I Have for Lunch?, demonstrate how to calculate weighted scores and final tallies for each option (see teacher tips for guidance).
- Have students critically assess and reflect upon the outcome of the matrix.

Part 2: Research and Debate

- Assign students roles as either concerned parents or Anytown Youth Soccer League (AYSL) representatives. Do not assign students to a side based on their own beliefs. Students must consider how to debate and construct an argument around the point they have been assigned, even if it is against what they believe.
- Stress that many questions in science are about why something happens. A major activity of science is uncovering and understanding causal connections (cause-and-effect) and determining what relationships exist. Repeating patterns give clues that scientists can use to start investigating or exploring possible reasons. Students should consider all the evidence and build an argument that supports or dismantles any cause-effect relationships proposed between crumb rubber and human health.
- There are eight segments to the debate for each team. You can construct groups so that one student is in charge of each part, or you can assign multiple students to some of the parts. The Question and Answer sections and the rebuttal section require students to react to what they have heard without additional time for preparation, so these sections may benefit from having multiple students participate. You can also assign some students to be city council, and have them participate in the question and answer sessions.
- Distribute the Debate Preparation handouts.
- Students should divide up the debate preparation so that each student participates in research. The whole team should agree on which points need to be covered and in what order those arguments will be made. Students may need to do some preliminary research into crumb rubber safety before they can determine which points they want to pursue.
- As students prepare for the debate, stress that they need to research both sides of the issue so they are prepared for the question and answer sections, as well as the rebuttal.
- You can adjust the format of the debate to fit your needs by adjusting the number of points to be covered, the time allowed for each part, and/or time allowed for arguments. The debate should be conducted in one class period.



REFLECT/ASSESS

Students should be able to:

- Evaluate the use of a decision matrix in making informed decisions.
- Explain how making a decision for one specific application may differ from making a more general decision.
- Discuss the importance of research in making an informed decision.
- Identify questions they still have about crumb rubber.
- Determine if there is a cause and effect relationship between crumb rubber and human health and support their claim with evidence.



EXTEND

Have students investigate the use of crumb rubber in their community.



JOURNAL QUESTION

Often in public discourse, a decision is presented as either right or wrong; however, most decisions are more complicated than that. Ask students to consider arguments or positions they have heard in the news that frame an issue as either for or against. Challenge them to answer the following question: People want to make decisions that are healthy for humans and good for the environment. Discuss how doing this may be more complicated than it seems.



WEBLINKS

General Information about Turf and Soccer Fields

Sports Field Management: Synthetic Turf:

<http://safesportsfields.cals.cornell.edu/synthetic-turf>

Fact sheets/Studies

Fact Sheet: Crumb-Rubber Infilled Synthetic Turf Athletic Fields:

https://www.health.ny.gov/environmental/outdoors/synthetic_turf/crumb-rubber_infilled/fact_sheet.htm

Recycled Rubber Facts:

<http://www.recycledrubberfacts.org/>

Tire Crumb and Synthetic Turf Field Literature and Report List as of Nov. 2015 (list of studies):

<https://www.epa.gov/chemical-research/tire-crumb-and-synthetic-turf-field-literature-and-report-list-nov-2015>

EPA: No current studies show elevated health risk from tire crumb:

<http://epnewswire.com/stories/510655160-epa-no-current-studies-show-elevated-health-risk-from-tire-crumb>

Federal Research on Recycled Tire Crumb Used on Playing Fields:

<https://www.epa.gov/chemical-research/federal-research-recycled-tire-crumb-used-playing-fields>

A Cocktail of Harmful Chemicals in Artificial Turf Infill:

<http://www.ceh.org/get-involved/take-action/a-cocktail-of-harmful-chemicals-in-artificial-turf-infill/>

Sports Field Management - Latest Crumb Rubber Research Study Supports it Safety:

<http://www.sportsfieldmanagementmagazine.com/the-latest/around-the-industry/latest-crumb-rubber-research-study-supports-it-safety/>

Rubber Infill Summary:

http://abysa.org/uploads/File/TurfReplacement/Turf_RubberInfillSummary.pdf

Anecdotal Evidence and Community Reports

Ann Catino Testimony:

http://abysa.org/uploads/File/TurfReplacement/Turf_AnnCatinoTestimony.pdf

<http://www.soccerwire.com/news/clubs/youth-boys/artificial-turf-and-cancer-espn-digs-into-crumb-rubber-risks-with-troubling-e60-report-by-julie-foudy/>

Artificial turf gets a closer look after report raises safety concerns:

https://www.washingtonpost.com/local/artificial-turf-is-getting-a-closer-look-after-a-report-raises-safety-concerns/2015/09/22/fcf6a0ee-5649-11e5-abe9-27d53f250b11_story.html?utm_term=.dd2eb7855fb7

Synthetic Turf and Cancer: Where Do We Go from Here?

<http://www.sportsfieldmanagementmagazine.com/maintenance/artificial-turf/synthetic-turf-and-cancer-where-do-we-go-from-here/>

Updated: Controversial Rubber Product Recommended for Asheville Fields:

<http://www.citizen-times.com/story/news/local/2016/03/28/controversial-rubber-product-recommended-asheville-soccer-fields/82359382/>

Chemical Exposure: Crumb Rubber vs. Natural Soil:

<https://www.recycledrubberfacts.org/turf/>

Investigation of Reported Cancer among Soccer Players in Washington State:

<http://www.doh.wa.gov/CommunityandEnvironment/Schools/EnvironmentalHealth/SyntheticTurf>

Synthetic Turf Fields, Crumb Rubber, and Alleged Cancer Risk:

<https://link.springer.com/article/10.1007/s40279-017-0735-x>
<http://www.semanticscholar.org/author/John-McMurray/1111111111>

Alternatives to Crumb Rubber

Overview of alternatives:

<http://www.sportsfieldmanagementmagazine.com/maintenance/artificial-turf/crumb-rubber-alternatives/>

Field Turf Organic Cork Infill:

<http://www.fieldturf.com/it/purefill>

Crumb Rubber or Organic Infill for Turf:

<http://americanrecycler.com/8568759/index.php/news/rubber-recycling/1207-crumb-rubber-or-organic-infill-for-synthetic-turf>

Organic Infill Replaces Car Tires in Turf:

http://www.csrwire.com/press_releases/37744-Organic-Infill-Replaces-Car-Tires-in-Turf

Gmax Testing

Impact testing:

<http://www.turftest.com/gmax-overview.html>



Background

Crumb rubber is a material made from recycled tires that is commonly used as infill in artificial turf, as well as in playgrounds. In recent years, the use of crumb rubber has been under fire as a potential carcinogen. The debate over crumb rubber is an interesting one, because it pits documented scientific research against anecdotal evidence and calls for further study. This controversy also highlights the intricacies involved in making decisions that are healthy for people and for the environment. In this activity, students are asked to debate the use of crumb rubber in one specific instance. Focusing on a specific case study forces students to weigh a number of issues including: price; viability of alternatives; health concerns; and the environment.

The Crumb Rubber Resources page for students contains a few links to general information, as well as one link that leads to a number of specific studies. All students should read these general documents to have a common starting point. The weblinks section in the lesson plan includes a number of other links that touch on subjects such as g-max ratings, alternatives to crumb rubber, and other details. These links can be provided to students for further research as they dig deeper and begin to collect evidence.

Constraints and Considerations

Many complex decisions have certain constraints and considerations that must be considered when making a choice. A constraint is a limitation or restriction. A possible choice that does not meet the constraint will not work. On the other hand, considerations are factors that you want to consider in making a decision, but are not “deal-breakers.” For example, imagine you are buying a car. There are five people and a large dog in your family. Your car must have room for five people and a dog. If it does not, the car will not work for your family. You would also like to get a car with good gas mileage, and you would prefer one that is blue. These factors are considerations, because a red car or one with only average gas mileage would still work for your family. You would just give more weight to a car that was blue and got good gas mileage if such a car were among your choices and had room for five people and a dog.

Using the Decision Matrix

- Make sure students fully understand how the Decision Matrix works before they use it for this activity. A sample based on what to eat for lunch is provided on the Decision Matrix handout. You may want to use a similar example to walk students through determining the factors to consider, as well.
- The score should reflect how well that choice fits that criteria. For example, crumb rubber is less expensive than organic infill, so you might give it a 4 for affordability, while you might give organic infill a score of 2. Infill options might have the same scores for certain criteria, and some criteria or categories may end up having the same weight.
- Discuss how to assign relative importance, or a weight, to each factor (see Decision Matrix General Instructions). This is a judgement call students should make. It is important for students to understand that they are not putting the factors in order of importance. Multiple factors may have the same importance.
- Students should critically think about whether or not the outcome makes sense overall. If it doesn't, it may mean students need to go back and review how they assigned values or weighted certain categories. Alternatively, it may mean that the matrix is revealing an outcome they hadn't fully anticipated, and thus should consider that option more seriously. The more often students practice using matrices, the more meaningful and reliable this tool becomes. Ultimately, the choice with the highest number does not have to be the final choice. The Decision Matrix is just one way to compare choices.

Crumb Rubber Headlines

(teachers can use one or all in motivate section)

- Feds Finally Take Action on Crumb Rubber Turf (NBC News)
- Are synthetic playing surfaces hazardous to athletes' health? The debate over 'crumb rubber' and cancer (LA Times)
- Mom of Goalie Who Died of Cancer Wants Answers on Artificial Turf (NBC News)
- Science may get sidelined in artificial turf debate (Science News)
- Debate over turf fields in Edina echoes national health concerns (Star News)
- 'Crumb Rubber' Fields Spark Health Debate at Pittsburgh-Area Schools (Allegheny Front)
- Crumb-rubber controversy continues as Naranche turf installed (Montana Standard)
- Trouble in the Turf: Is crumb rubber causing cancer in athletes? (KSFY ABC)
- Lawmakers weighing risks of crumb rubber for playfields (Herald)
- Turf Battle: The Controversy Over Crumb Rubber Playing Fields (CBS Denver)

Crumb Rubber Headlines

(teachers can use one or all in motivate section)

- A Long Way from the Astrodome: Turfs Become Safer, More Prevalent (The Chronicle-Telegram, Ohio)
- Fear vs. Facts (Scrap Magazine)
- Synthetic Turf Comes Under Fire but Lack of Proof Makes it a Preferred Playing Field Surface (USA Today)
- Why Science Over Speculation Matters When It Comes to the Turf Debate (Huffington Post)

Crumb Rubber Images



The Crumb Rubber Debate



Crumb rubber, made from recycled tires, is a common ingredient used in playgrounds and as infill in turf fields. Recently, however, some parents and community leaders have been questioning the safety of crumb rubber. In this activity, you will look at one specific case where a community is debating the use of crumb rubber in their soccer fields. You will weigh all the factors, debate the safety of crumb rubber, and make a recommendation about what kind of infill should be used.

Materials

- Computer with internet access

Part I: Case Study

1. Read the Anytown USA Soccer Fields Case Study.
2. Make a list of the constraints and considerations of the re-turfing project.
3. A decision matrix is a way to visualize all the factors that need to be considered when comparing options. Fill out the categories/criteria column of the matrix. These should reflect the factors you will need to consider when deciding what type of infill is best for the Anytown soccer field re-turfing project.
4. Research crumb rubber and organic infill options, using the websites your teacher gives you as a starting point.
5. Based on your research, add possible infill options (crumb rubber, organic, other) to the matrix.
6. Complete the decision matrix and calculate total weighted scores for each option and compare.
7. Do any of these options fail to meet the constraints you identified for the project? If so, eliminate that option.

Part II: Research and Debate

1. Your teacher will assign you a role as either a member of the concerned parents group or a representative for the Anytown Youth Soccer League. You will work with other students assigned to the same role to present your argument for or against the use of crumb rubber infill in the new soccer fields to the Anytown City Council in a debate format.
2. Each team will give an introduction, present three main points in favor of their argument, and have three chances for rebuttal of the opposite side's points. In addition, each side will have a chance to ask questions of the opposing side after they present each of their main points. Two of the three main points from each side should focus on safety considerations, while one point should be based on the other factors in the Decision Matrix.
3. Research the safety of crumb rubber. Use the information you gather and the Debate Planner handout to plan your debate strategy. Your arguments must be built on evidence, such as citing specific studies.
4. Prepare for the debate with your team. Have each team member present their speech, while the other team members give feedback. You may also want to practice asking questions you think the other side may ask.
5. Conduct the debate.

Reflect and Apply

1. Did the decision matrix make the decision-making process easier? Why or why not?
2. Did the result of the decision matrix match the decision you were leaning towards? Why do you think that is?
3. How might you use the decision-making process you used in this activity to make other decisions in your life?
4. Do you think you might have reached a different decision about whether crumb rubber or an organic infill was better if there was no specific field in mind? Why or why not?
5. What is the importance of research in making informed decisions? What kinds of resources are most valuable in these decisions?
6. What questions do you still have about crumb rubber? What kinds of questions would you ask to determine the best infill solution for artificial turf in a specific location?
7. Do you think that there is a cause and effect relationship between crumb rubber and human health? What is your evidence and what more would you want to know? How does this compare with the position you took in the debate?

Extension

Investigate the use of crumb rubber in your community.



JOURNAL QUESTION

Most people want to make decisions that are healthy for humans and good for the environment. Discuss how doing this may be more complicated than it seems

Student Name:

Period:

Anytown Soccer Field Re-turfing Project Case Study

Anytown is proud of its soccer complex. The complex was built ten years ago, and has turf fields made using crumb rubber as an infill material. The soccer fields are used heavily by the town. The community youth soccer league plays there, as well as the competitive youth soccer program, and the adult soccer league. Many people enjoy playing pick-up soccer on these fields, as well. These groups also host soccer tournaments on the field several times a year. The fields are used at least six hours a day most times of the year. With all this heavy usage, the fields have become worn and need to be replaced.

The Anytown city council has agreed to cover the cost of re-turfing the fields. They have allocated funds based on the median costs for a soccer complex the size of theirs. They have also agreed to allocate funds for re-turfing the fields again in ten years. The fields are in a flood plain, where they get mild to moderate flooding every few years, with an occasional major flood. The city council wants to be sure that this fact is taken into consideration so they won't be asked to replace the fields earlier than planned. The youth soccer league want to be sure that the fields meet the g-max ratings required by the U.S. soccer organization. This rating is to make sure that fields are soft enough and have enough give to cut down on injuries when kids fall.

All artificial turfs use some kind of infill that is spread between the fibers of the turf. The Anytown fields use a common material called crumb rubber as infill. This material is made of rubber recycled from tires. The Anytown Youth Soccer League and city council were planning to use crumb rubber again. However a concerned group of parents has asked the city council to rethink this choice. They point to a growing concern that crumb rubber may be carcinogenic. They point to some evidence, mostly anecdotal, that kids who play on crumb rubber fields are developing cancer. They are urging that the council look at alternatives such as organic infill instead of crumb rubber.

General Instructions for Using the Decision Matrix

1. List each criterion (or factor) you need to consider when deciding what type of infill is best for the Anytown soccer fields. For example, price might be one factor.
2. Assign a weight for each criterion from 1 to 5, (with 5 as the highest value). This should reflect how important you think the criterion is. For example, you might think price is not very important since you could always raise more money if needed. In that case, you might assign affordability a weight of 1. However, if you think price is highly important since the city council has given a specific budget, you might assign affordability a weight of 4 or 5. This is a judgement call you should make.
3. For each criterion, score each option on a scale of 0-5 (5 being best) based on how well that option seems to meet the criteria.
4. Multiply the weight for each category by the score you gave each option to get the weighted score. Calculate total weighted scores for each option and compare.

Sample Completed Matrix

What Should I Have for Lunch?			Options			
			Hamburger	Salad	Option C	Option D
Selection Criteria/Category	Weight (1-5)	Multiply	Score Weighted Score	Score Weighted Score	Score Weighted Score	Score Weighted Score
Taste (Should taste good)	5	x	5 =25	2 =10		
Nutrition (Should be healthy)	2	x	2 =4	5 =10		
Cost (Less expensive scores higher)	3	x	3 =9	3 =9		
	TOTAL SCORE	=	38	29		

Debate Planner

Argument Overviews

Anytown Youth Soccer League – FOR using crumb rubber when re-turfing the town’s soccer fields.

Concerned Parents Group – AGAINST using crumb rubber on the town’s soccer fields.

Both sides will present their arguments in front of the City Council in the debate format below.

Debate Format

Group	Topic	Time
Anytown Youth Soccer League (AYSL)	Introduction	4 minutes
Concerned Parents Group	Introduction	4 minutes
AYSL	Point 1	4 minutes
Parents	Q and A	2 minutes
Parents	Point 1	4 minutes
AYSL	Q and A	2 minutes
AYSL	Point 2	4 minutes
Parents	Q and A	2 minutes
Parents	Point 2	4 minutes
AYSL	Q and A	2 minutes
AYSL	Point 3	4 minutes
Parents	Q and A	2 minutes
Parents	Point 3	4 minutes
AYSL	Q and A	2 minutes
Parents	Rebuttal all points	4 minutes
AYSL	Rebuttal all points	4 minutes

Team Responsibilities and Argument Order

Part	Topic	Important Ideas	Assigned Person	Sources to Use
Introduction				
Point 1				
Point 2				
Point 3				
Q and A point 1				
Q and A point 2				
Q and A point 3				
Rebuttal				

Questions for Consideration

Introduction

- What is the overall goal of your argument?
- What main points will your argument cover?
- What are some general statistics, examples, or other evidence you can present to support your argument? Don't go too deep here. That should be reserved for the point arguments.

Point Arguments

- What is the main point you are trying to make?
- Why should people care about this point?
- What are some specific studies, statistics, examples, or other evidence you can use to support your argument? Be specific.
- Exactly how do these facts or studies support your argument?

Q and A sessions

- What points might the other side bring up?
- What are some general question topics you might want to cover? Remember that questions will be restricted to the specific point the opposing side has made.
- What would you like to achieve by asking these questions? What will your side gain from them?

Rebuttal

- What are the weaknesses in your argument?
- What evidence could the opposing side give to refute your argument?
- How can you counter this evidence?

Crumb Rubber Resources (all students should read)

General Information

Fact Sheet: Crumb-Rubber Infilled Synthetic Turf Athletic Fields:

https://www.health.ny.gov/environmental/outdoors/synthetic_turf/crumb-rubber_infilled/fact_sheet.htm

Are synthetic playing surfaces hazardous to athletes' health? The debate over 'crumb rubber' and cancer:

<http://www.latimes.com/sports/la-sp-artificial-turf-debate-20160229-story.html>

Research Studies

Synthetic Turf Research at Penn State:

<http://plantscience.psu.edu/research/centers/ssrc/research/synthetic-turf-research-penn-state>