

# Turf vs Grass: The Effects of Heat

## Engineering Goal: Grass fields are more beneficial than turf fields because they do not absorb heat as quickly and as much as turf fields do.

### Introduction

Since 1967, there have been abrupt changes in the composition of turf fields and how they are made. This project will inform people of the differences given by heat on turf and natural grass. Recent research of turf shows its issues as in health and economic problems, and its benefits, such as better quality and no extra spending on things like fertilizers or lawn mowers. Natural grass has been compared to turf to spread the message to sport players, coaches, and/or organizations about how natural grass has more health benefits rather than artificial turf. "Synthetic turf is made of plastics with different composite materials and is supported by a sand and/or rubber infill material and subsurface base layer." (American Society of Civil Engineers) The color of these small pieces of turf (pebbles) are black which is known to absorb sunlight and heat, especially on very hot days. Along with the material turf is made of, this can be extremely dangerous and lead to heat related injuries like a stroke. When the temperature reaches a specific level, you can physically see heat waves rising above the turf field. "Turf material significantly affects the microenvironment and heat-stress sensation of sports-field users." (Science Direct)

A recent study shows that material in artificial turf is made from scrap tires. "Tire rubber crumb contains a range of organic contaminants and heavy metals that can volatilize into the air and/or leach into the percolating rainwater, thereby posing a potential risk to the environment and human health." (American Chemical Society Publications) Tire waste in general has been a problem for the environment because it is highly durable, can trap heat, and can even be a possible fire hazard. Scrap tire and ground rubber are the makeup of turf pebbles.

Injuries can also be caused by the friction of shoes on the surface of the field. "The traction between a sports shoe and an athletic surface is important for both the performance and the safety of the athlete." (Fieldturf Inc. NIKE Inc. [www.brockusa.com](http://www.brockusa.com)). During activity, athletes run, start and stop quickly, change directions rapidly, and this creates high "horizontal" forces between the cleat or sneaker and the field being played on. Due to the way turf fields are made, many athletes have found that using grass designed cleats on artificial fields do not provide enough "slip resistance" so new shoes were created to improve the grip on the turf. However, these new designs have caused foot problems or "foot fixation." This can lead to not only foot injuries, but knee injuries as well. "High school football players wearing shoes with shorter cleats had a lower injury rate than those using longer cleats, a difference attributable to differences in the shoes' rotational traction." (Fieldturf Inc. NIKE Inc. [www.brockusa.com](http://www.brockusa.com)). More recently, shoes with peripheral cleats have a higher injury rate. The best type of cleats to wear on turf are conical or blade-like in shape or ones that are made of plastic, rubber or metal.

However, even though people prefer to use turf because it does have some benefits; "such as lower maintenance, no irrigation required, and surface uniformity" (Science Direct) players agree that using grass fields is more beneficial to play on rather than turf fields. In a study that was done in 2014, thousands of registered Elite soccer players were given a questionnaire on the benefits of grass vs. turf. The three questions these athletes were asked were background information about the players, their experience with different surfaces, and questions about the direct comparison of turf and grass fields. Based on the results from this, about 50% of players feel that turf fields have less grip than grass, and around 25% feel that there is too little grip. This is important because having good grip on the surface can prevent injuries when players are moving and changing directions at fast speeds. In another section, about 50% of players thought that turf was more abrasive than grass and 15% thought turf is too abrasive. Athletes get "turf burn" if they fall on turf fields and it causes scratching against the top layer of your skin. "These abrasions, which are due to friction, can tear into the top layer of skin. It may feel as if your skin has been scraped against sandpaper." (Turfburn: What you should know, Healthline.com)

This can be a challenge for players playing games like football or field hockey where players fall down many times during a game. When playing on grass you do not have to worry about infection from the chemicals in turf particles or the bacteria from other players that rest on the surface or turf. Since this study was published in 2014, this means that changes may have occurred in the opinions of players or new properties in turf have been made. However, the study is based on opinion so the opinions of each individual player have most likely stayed the same.

### Conclusion:

After completing the experiment, the results show that the turf sample had a higher temperature after 30 minutes than the grass sample. This proves the goal that turf absorbs heat more and faster than grass does. In Trial three, both turf and grass samples had a starting temperature of 22 degrees Celsius. After ten minutes, turf was at 28 degrees Celsius, and grass was at 26 degrees Celsius. After 20 minutes, the turf was at 28.5 degrees Celsius, and grass remained at the same temperature. After a total of 30 minutes, turf reached 30 degrees Celsius, and grass only reached 27 degrees Celsius. Using the data and knowledge of turf and grass, turf becomes heated faster due to the black rubber pebbles within the turf. These pebbles are what mainly contributed to the rapid heat rise because they are more absorbent than grass. Grass is a plant and therefore it uses photosynthesis to absorb sunlight and use it to create food to sustain its life. In contrast, turf is artificial and just absorbs the heat and gives it off from the sun.

From this research we can conclude that grass is the safer option when it comes to choosing field surfaces because there are less risks. These risks include physical problems involving the ankles and knees, heat problems like strokes. When an athlete is running or changing directions rapidly, it can lead to ankle and knee problems because of the impact on their bodies from the firmness of the turf. Heat related problems like strokes can happen because of the high temperatures caused by the material of the turf. Even though turf fields tend to be more sustainable and more popular due to the fast-paced games and the financial benefits, because of these health risks that come along with turf fields, grass fields are more beneficial to humans.

### Real World Application:

This project can be applied to the real world in the more common issue of athletic injuries. Thousands of athletes per year suffer athletic injuries from different frictions of surfaces or just playing their game. This project that focuses on the effect of heat on turf and natural grass is a real-world issue because athletes are exposed to these artificial turf fields for weeks at a time. However, without coaches or athletes knowing how the common issues of heat strokes are more frequent in these field. This can cause more injuries to happen. Athletes and coaches need to take into consideration the possibly amplified heat on turf fields before being pushed to their limit in practices of games. Often, coaches push their athletes to work harder when they seem exhausted, but really, it's the field and the heat radiating from it that is making them tired. Turf can be a useful resource for avoiding weather cancellations and prices, but it can jeopardize the health of the athletes if not used correctly with precautions. Another factor as to why grass fields are more beneficial is because turf fields hold on to bacteria and germs as long as nine days, with diseases like the common cold and flu.

### Future Work:

This project can be expanded into a larger experiment in the future by using real players from various sports including soccer, football, lacrosse, and field hockey. This experiment can be expanded is by using an actual field on a summer day and measuring the increase in temperature throughout the day, as well as measuring the increase in temperature. Another factor that can be included is the amount of sunlight on an artificial turf field and a grass field. The experiment performed in this project was done in the late fall with a heat lamp instead of a field with the sun being exposed to it. By comparing the temperatures to the sun on a hot day, using both artificial turf and grass fields, it will show a real-life representation of the heat differences of turf and grass. Another way this experiment could get the real aftermath of the increase in temperature is by recording testing the friction of cleats used on these fields before and after playing. This would be used to determine whether the friction of cleats on turf and grass fields effect the rise in temperature and heat related injuries as well.

### Materials:

- Heat Lamp
- Sample of Turf
- Sample of Grass
- Two Thermometers
  - One for Turf
  - One for Grass
- Balance
- Two Petri Dishes
- Stopwatch

### Procedure:

1. Measure equal amounts of samples of turf and grass in two petri dishes (one for each sample)
2. Place each sample under the heat lamp so they have even distribution of heat
3. Before the lamp is turned on, take the temperature of the two samples using two different thermometers (this is the control)
4. Turn the lamp on and at the same time turn on the stopwatch
5. Record the temperature of each sample every ten minutes, leave the heat lamp on while measuring.
6. Repeat these recording for a total of 30 minutes of 10-minute intervals. Each recording will be taken for one full minute.



Disclaimer: this picture was taken by creator

### Results:

#### Trial 1:

Amount of time (min)	Turf temp. (C°)	Grass temp. (C°)
0	20	19
10	25.5	24
20	27	25
30	28	26

#### Trial 2:

Amount of time (min)	Turf temp. (C°)	Grass temp. (C°)
0	22	22
10	28	26
20	28.5	26
30	30	27

#### Trial 3:

Amount of time (min)	Turf temp. (C°)	Grass temp. (C°)
0	21	22
10	29	27
20	30	29
30	32	27

