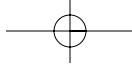


# Facts About Artificial Turf and Natural Grass



Published by the  
Turfgrass Resource Center  
<http://www.turfgrassod.org/trc/index.html>



## Facts About Artificial Turf and Natural Grass

*(Published by The Turf Resource Center)*

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*"Until man duplicates a blade of grass, nature can laugh at his so called scientific knowledge."*

—Thomas Edison

*"I would never like to see artificial turf. I'm very happy with what we have."*

—Bill Cowher, Steelers coach

*"Nature never did betray The Heart that Loved her."*

—William Wordsworth

*"If a horse can't eat it, I don't want to play on it..."*

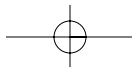
—Dick Allen, former major league  
baseball player (Phillies & White Sox)

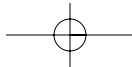
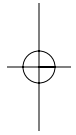
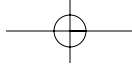
*"To waste, to destroy our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the days of our children the very prosperity which we ought by right to hand down to them amplified and developed."*

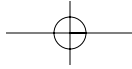
—Theodore Roosevelt

*"The Supreme Reality of Our Time is...the Vulnerability of our Planet"*

—John F. Kennedy





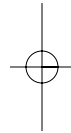
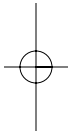


# *F*acts About Artificial Turf and Natural Grass

## Introduction

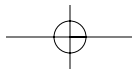
The decision of whether to install artificial turf or natural grass is one that requires serious consideration of all related science-based information. Current trends should be put aside in favor of the facts that can have short- and long-term rewards or consequences. Unsubstantiated claims, over-statements, mis-statements or misunderstandings and fads should not be part of the decision making process.

While there are situations when artificial turf might be an appropriate choice, scientific research documents the significant environmental, health and safety benefits of natural grass which logically should be the first consideration. The true costs of proper installation, care and maintenance of artificial turf fields varies as widely as those of natural grass. The key word is “proper,” as in whatever it takes to maintain high quality fields. The most reliable means for estimating true costs is to request a comprehensive bid proposal from artificial turf and natural turfgrass producers, inclusive of actual costs for pre-installation field preparation, installation, post-installation care and maintenance—including annual and seasonal maintenance and repair for an extended period of time such as five or 10 years.



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## What Decision-Makers Need to Know

In order to make fiscally and environmentally sound decisions regarding the potential purchase and installation of artificial turf or natural grass in their communities, decision makers have the responsibility to consider all short- and long-term issues and concerns. The following information has been assembled to help them make the appropriate decision.

### What Is Artificial Turf?

Artificial turf was first invented in 1965. The first synthetic turf fields were not much more than green plastic indoor-outdoor carpet. At the time, some members of the industry thought that as more teams moved to indoor stadium, grass would not grow as well and would require a substitute.

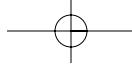
The advantages of artificial turf lie in its ability to withstand heavy use, even during or immediately after a rainstorm. Fields enduring high traffic situations throughout the year (particularly winter) benefit from its durability and effective drainage systems when properly incorporated into the field design. Artificial fields require a different type but just as extensive maintenance protocol as natural grass, particularly if used regularly for a multitude of sports regularly.

*“Although many types of turf undergo university trials, there is a lack of information on the long-term impact of artificial turf.”*

Yet as of 2004, the majority of professional sports fields still used natural grass. In the NFL, two-thirds of the stadiums (20 fields) used natural grass while 11 stadiums used artificial turf. Even more dramatically, only four of 30 baseball stadiums chose artificial turf. In Europe and North America, some soccer clubs converted to synthetic turf in the 1980s, but soon converted back to natural turf when both players and spectators complained. Not only did players find the hard surface unforgiving but the bounce of the ball was affected, changing the dynamics of the games. Although the Federation International de Football Association allows the use of synthetic turf, some international soccer teams absolutely refuse to play on artificial turf.

While artificial turf today has evolved from the plastic mats of old, the “turf” is still attached to such a mat, with the fibers composed of polyethylene lubricated with silicone. A layer of expanded polypropylene or rubber granules (made mostly from recycled car tires) and sand serve as an “infill” to add shock absorbency. It is recommended that this infill be replenished on a regular basis.

Although many types of turf undergo university trials, there is a lack of information on the long-term impact of artificial turf. While government organizations like the Department of Agriculture and the Environmental



## What Decision-Makers Need to Know

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Protection Agency exist to educate users and oversee the effects of natural grass, there are no government restrictions or guidance in reference to artificial turf.

### A Standard of Comparison

The following booklet examines the six major considerations one should analyze when comparing artificial turf and natural grass:

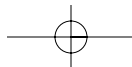
- Financial Considerations
- Wear and Durability
- Human Health Effects
- Environmental Health Effects
- Mental and Emotional Impact
- Choosing Your Future

While modern artificial turf has evolved considerably since AstroTurf<sup>®</sup>, so has modern natural grass. Natural grass fields of yesterday that were often muddy, rough or simply unplayable have been replaced with modern turfgrass varieties developed for greater durability, even under heavy traffic conditions. Different types of natural grass fields are referred to throughout this document; the most modern fields have significant drainage, at least 90 percent uniform sand in the profile mix, and the best varieties of sports turfgrass.

Natural soil or native soil fields have soil compaction and drainage limitations that are overcome with the improved, soil-modified fields. Native soil fields should only be used when they are necessitated by financial limitations. For native soil fields to have any hope of providing quality turf under average traffic conditions, they must have proper pitch or slope and adequate perimeter drainage.

In both theoretical and practical terms, a fair comparison between natural grass and artificial turf should include the most modern, technologically advanced fields available on both counts.

Some sources are perpetuating unsubstantiated claims about artificial turf. Many questions about the effects of artificial turf remain unanswered. Each category will compare some common myths to the facts of how artificial turf and natural grass impact the people, organizations and communities around it.



# *F*inancial Considerations

Since conditions and requirements vary, there is no one, definitive answer or figure to describe the costs of constructing and maintaining a natural turf field or a synthetic field. Therefore, consulting the experiences of other field builders and users provides a method of estimating costs.

**MYTH:** *Artificial turf saves money because of its longevity.*

**FACT:** *While the factors influencing costs vary from field to field, construction costs for an artificial turf field generally far outweigh construction costs for a natural field.*

## Dollar for Dollar

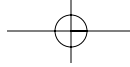
The SportsTurf Managers Association recently produced a guide to construction and maintenance of all field types that demonstrates the affordability of natural grass:<sup>1</sup>

Synthetic Turf/infill . . . . .	US \$7.80-\$10.75 per sq. ft. (US \$83.96-\$115.71 per m <sup>2</sup> )
Natural grass with sand and drainage . . . . .	US \$6.50-\$7.95 per sq. ft. (US \$69.97-\$85.57 per m <sup>2</sup> )
Natural grass with sand cap . . . . .	US \$3.50-\$5.25 per sq. ft. (US \$37.67-\$56.51 per m <sup>2</sup> )
Natural grass with native soils. . . . .	US \$2.50-\$5.25 per sq. ft. (US \$26.91-\$56.51 per m <sup>2</sup> )
Natural grass with on-site native soil . . . . .	less than \$1 per sq. ft. (US \$10.76 per m <sup>2</sup> )

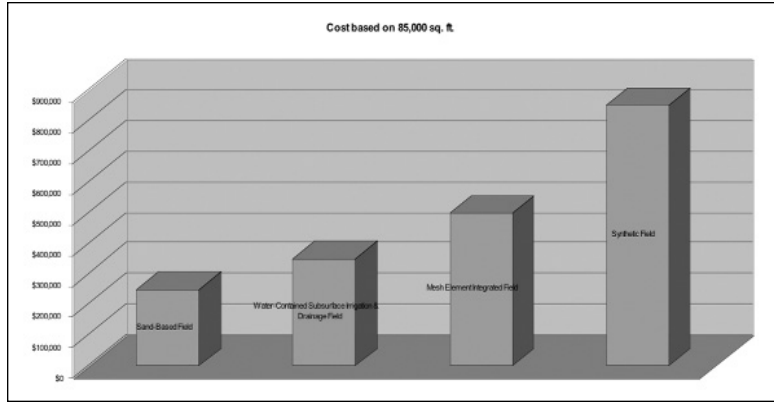
## In the Words of a Professional Sports Field Contractor

When comparing one Midwestern sports field contractor's rates between artificial turf and the modern natural grass field, it is clear that the natural grass fields are less expensive to construct. A fair comparison between the field types parallels modern artificial fields and sand-based natural grass fields or improved sand based fields, since only these fields are capable of enduring the extreme wear and weather conditions becoming increasingly common at most schools.<sup>2</sup>

The cost range of the three types of sand-based fields with natural grass fields and synthetic turf are listed below. This particular installer also offers fields which incorporate segments of polypropylene netting with a sand-based field (the mesh element integrated field) and a new type of natural grass field which requires less than 50 percent of the water of a general sand-based field (known as a water-contained sub-surface field).



Financial Considerations



**Natural Grass Fields**

- Sand based field (peat or soil mix) . . . . . US \$250,000-\$350,000
  - Water-contained sub-surface  
Irrigation & drainage field (pure sand) . . . . . US \$350,000-\$500,000
  - Mesh element integrated field (sand/peat) . . . . . US \$500,000-\$600,000
  - Synthetic field. . . . . US \$850,000-\$1,000,000
- (note: all of the above fields are based on 85,000 sq. ft./7,897 m<sup>2</sup>)*

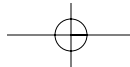
**MYTH:** *Artificial turf requires little maintenance, and therefore, little if any annual costs.*

**FACT:** *While in some cases, annual maintenance costs may be lower for artificial turf, there are still significant costs involved. Artificial turf fields still require personnel and equipment for dragging, cleaning, carpet repair and infill additions and redistribution. When maintenance costs are combined with construction costs, a natural grass field generally averages out to less cost per year than an artificial field.*

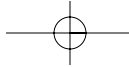
**Case study: Springfield College<sup>3</sup>**

Like a similar study at B.Y.U., this Massachusetts school found that when installation and maintenance costs were combined, natural grass was a more affordable choice than artificial turf.

Springfield College. . . . .	Artificial Turf . . . . .	Natural Grass
Cost to Install . . . . .	US \$800,000 . . . . .	US \$400,000
Cost to Maintain per Year . . . . .	US \$5,000 . . . . .	US \$28,000
8-Year maintenance costs . . . . .	US \$40,000 . . . . .	US \$224,000 (life of the field)
8-Year total costs . . . . .	US \$840,000 . . . . .	US \$624,000 (all costs combined)
<b>Average cost per year . . . . .</b>	<b>US \$105,000 . . . . .</b>	<b>US \$78,000</b>







### Equipment Required

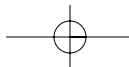
The initial cost of purchasing maintenance equipment for a synthetic turf field can cost as much as the equipment needed to maintain a natural grass field. The following is a comparative list of basic equipment for artificial turf and natural grass care and estimated costs, excluding any repair costs.<sup>4</sup>

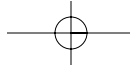
### Cost of Equipment, Supplies and Labor Required for Maintaining Artificial Turf and Natural Grass:

<b>Artificial Turf</b>	<b>Natural Grass</b>
Irrigation (for cooling) . . . . . US \$6,000-35,000	Irrigation . . . . . US \$6,000-35,000
Boom Sprayer . . . . . US \$1,000-35,000	Boom Sprayer . . . . . US \$3,000-31,000
Sweeper . . . . . US \$1,500-20,000	Mower . . . . . US \$13,000-69,000
Mechanical Broom . . . . . US \$500-3,000	Fertilizer Applicator . . . . . US \$1,000-3,000
Line Painter . . . . . US \$500-3,000	Painter, line . . . . . US \$700-3,000
Groomer . . . . . US \$1,500-2,000	Rollers . . . . . US \$2,000-4,000
Cart (for towing equip.) US \$7,000-16,000	Cart (for towing equip.) US \$7,000-18,500
Field Magnet . . . . . US \$500-1,000	Aerator . . . . . US \$3,500-17,000
Rollers . . . . . US \$250-2,000	Vacuum . . . . . US \$2,100-5,000
Top Dresser . . . . . US \$4,500-10,000	Top Dresser . . . . . US \$4,500-20,000
<b>Total . . . . . US \$23,250-127,000</b>	<b>Total . . . . . US \$42,800-205,500</b>

### Annual Maintenance Required for:

<b>Artificial Turf</b>	<b>Natural Grass</b>
Painting/removal (various sports) . . . . . US \$1,000-10,000	Painting (various sports) . . . . . US \$800-12,300
Top Dressing/Infill . . . . . US \$ ??	Top Dressing (sand) . . . . . US \$0-5,400
Brushing/sweeping . . . . . US \$1,000-5000	Dragging . . . . . US \$0-200
Disinfecting . . . . . US \$ ??	Fertilizers . . . . . US \$1,200-11,000
Carpet Repair (rips, joints) . . . . . US \$1,000-3,000	Pesticides . . . . . US \$650-6,300
Water Cooling . . . . . US \$5,000-10,000	Aeration . . . . . US \$700-960
Weeding . . . . . US \$500-1,000	Sod Replacement . . . US \$833-US \$12,500
<b>Total . . . . . US \$8,500-US \$29,000</b>	<b>Total . . . . . US \$8,133-US \$48,960</b>





Financial Considerations

**A Year in the Maintenance Life of Synthetic Turf**

At Michigan State University, artificial field maintenance during the 2004-2005 season was found to be even higher than Springfield College's figures, demonstrating that sometimes numbers can vary greatly depending upon the individual field and its use. The following figures reflect the field surface's third year of use.<sup>5</sup>

Total supply cost . . . . .	US \$6,220
Total equipment cost & repairs . . . . .	US \$3,500
Total outside contractor repairs . . . . .	US \$8,000
<b>Total maintenance cost . . . . .</b>	<b>US \$17,720</b>

**Solutions for Schools and Public Agencies**

Dr. Brad Fresenburg, a turfgrass specialist at the University of Missouri, Division of Plant Sciences, completed a comparison study of natural grass and artificial turf. Like the above examples, Dr. Fresenburg found that when annual maintenance costs and installation costs were combined, natural grass fields were a better value. He calculated an annual average cost for each field type, based on a 16-year scenario:

Native soil-based field . . . . .	US \$33,522
Sand-based field . . . . .	US \$68,545
Sand-cap grass field . . . . .	US \$49,318
Basic synthetic field . . . . .	US \$65,846
Premium synthetic field . . . . .	US \$109,013

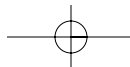
Dr. Fresenburg notes that for the cost of installing a synthetic field, an organization could install a natural sand-cap grass field, then place the remaining money into a maintenance fund.<sup>6</sup>

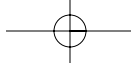
**MYTH:** *Because artificial turf is synthetic, it will last forever.*

**FACT:** *Artificial turf has a projected lifespan of approximately eight years, does not have the regenerative properties of natural turf, and requires significant additional costs for removal and disposal.*

**Hidden Costs**

Michigan State University Athletic Turf Manager Amy Fouty found that not only was artificial turf not maintenance free, but that maintenance costs alone were only part of the expense. Fouty's annual equipment budget varied from US \$8,250 to almost US \$82,000. The need for outside contractors to consult or train maintenance staff could cost as much as US \$3,000 a day, resulting in US \$30 to US \$70 per linear foot for repairs.<sup>7</sup>





Unlike natural grass, artificial turf cannot regenerate and grow in or be quickly sodded to fill spots or damage marks. One university recorded an annual cost of US \$13,000 to repair damage and replenish the field (seam repairs—US \$8,000, application of crumb rubber—US \$5,000). On another professional field, repeated painting of an artificial field as it changed from one sport to another and back again totaled more than US \$100,000 in one year.

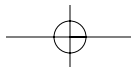
### Lifespan Study

Dr. A.J. Powell, a leading turfgrass agronomist with the University of Kentucky, conducted a research study to analyze costs involved with installing and maintaining both natural grass and synthetic fields.

Contrary to others' experience, Dr. Powell felt that installing a new sand-based field would actually cost more than an artificial FieldTurf construction. However, because the synthetic field would need to be replaced after approximately eight years, the long-term value favors the natural grass field. Properly installed and maintained quality natural grass remains viable for at least twice as long, exponentially increasing the costs for a synthetic field based on the need to tear up, totally remove and reinstall new artificial turf every eight to ten years or even more often.<sup>8</sup>

### Disposal Costs

For the removal and disposal of an artificial surface, sports field managers can expect these costs to run at least US \$1.75-US \$2.25 per sq. ft., not including transportation costs and any landfill surcharges that disposal might incur. This cost will arise in conjunction with a new field's construction, boosting the up-front costs required.<sup>9</sup> Many of the modern artificial turf fields installed in the last decade will be reaching this stage in the next few years, raising the awareness of these costs.



## Wear and Durability

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**MYTH:** *Because artificial turf is synthetic, it can endure endless use without the need for maintenance.*

**FACT:** *Artificial turf requires regular as well as semi-annual maintenance, including the addition of infill, cleanup of dropped or thrown objects and repair and restoration from wear, the same as natural grass.*

### It's the Little Things

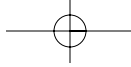
Whether by hand or with field magnets, small objects and materials must be meticulously removed; liquids or other residues must be thoroughly cleaned and disinfected. Some common elements that field managers must cleanse or remove after events include:

- Blood
- Spit
- Urine
- Vomit
- Food and beverages
- Gum
- Metal particles
- Wooden splinters
- Animal droppings

### Correcting Problems, Creating New Ones

Static cling is also a nuisance for synthetic turf fields and requires diluted fabric softener to be sprayed on the field. The softener also serves to retard the odor – described by some as the smell of “old tires and locker rooms” – that comes from the rubber infill. However, the application of softener can make the field slippery for players.

While an artificial surface may seem smoother, lines are not easier to apply and remove. Painting lines has been found to create problems because the paint soon spreads, leading to messy lines and unsafe, slippery conditions. Other methods for creating lines on artificial turf is to “tuft-in” colored pieces, glue in sections or stitching during manufacturing. These efforts all come at a cost to accommodate various sports such as lacrosse, soccer and football.



## Unanswered Questions

As sprays like algaecides and fabric softener are applied to a synthetic field for various reasons, the field can become slippery or the chemicals potentially harmful to players and the synthetic components of the surface itself. Do you leave the field with problems or add the sprays?

Every time you sanitize, you wash away the sprays. Do you reapply every time?

What effect do weed-stopping chemicals designed for use on concrete have on the structure of the synthetic turf surface?

As chemicals and sprays are repeatedly applied and washed off again, what effect do these have on the groundwater supply?

Since infill needs to be replenished repeatedly over the life of a synthetic field, a new concern is discovering what became of the “old infill.” How much of it ends up where? As infill is played on, some of it merely settles. Some of it breaks down, allowing part of the field to literally walk away with players after each use, stuck on their cleats, uniforms and bodies. Some of it washes away with a drainage system and even rain run-off. The extent of the effects of this “runaway” infill are still unknown.

**MYTH:** *Synthetic fields drain water better than natural turf.*

**FACT:** *Owners of artificial turf fields are discovering problems with the drainage systems.*

While synthetic fields include drainage systems, many field owners have discovered that these complex systems work incorrectly or inefficiently.

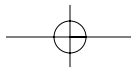
### Case study: Ford Field (Detroit Lions)

Ford Field, a synthetic turf surface, is a US \$500 million multi-use facility built in 2002. Home of the Detroit Lions, the venue was designed to host 120 events a year. Sports Field Manager Charlie Coffin and the field owners “were sold these fields on the basis that there would be no maintenance. That just wasn’t true,” says Coffin.

Since the field was covered, planners decided that the field didn’t need a drainage system. Contamination and erasing paint lines are now significant issues with no rainfall and nowhere for water to flow when applied.

### Case study: Brigham Young University (B.Y.U.)

When this university’s synthetic field was installed, the company claimed a drainage rate of 60 inches (152 cm) per hour. A system under the artificial carpet was designed to move water from the surface into an extensive drain mat system. The drainage system made up two thirds of the overall cost of the field



## Wear and Durability

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(in this case, US \$1.7 million of US \$2.5 million total costs). After installation, B.Y.U. found the surface to be hydrophobic and the undersurface poorly engineered, leading to water retention rather than drainage, with the drain mat typically seeing little or no water.<sup>10</sup>

### Case study: Portage High School, Indiana

When this high school installed its artificial turf, it was “ballyhooed for its ability to handle large amounts of rain,” yet ended up unplayable after the first heavy rain. Officials found that the field was not draining, nor were the sidelines. The ball would not bounce or roll due to where the water remained on the field. Coach Danny Jeftich of the opposing team noted that, “It was a hard rain, but it should’ve drained much faster,” citing that he had observed better drainage on natural grass fields. “Last year, there was a downpour before the semi-state [finals], and it drained in 10, 15 minutes,” said Jeftich in reference to the grass fields.<sup>11</sup>

**MYTH:** *Artificial fields are more durable than natural grass fields.*

**FACT:** *Natural turf has been cultivated to endure a wider variety of conditions than ever and has the added benefit of being capable of self-repair.*

How long does it take for man to copy something that nature has spent thousands of years perfecting?

While man struggles to create an imitation of turf with even half the benefits of natural grass, other scientists are working with nature to develop stronger, more wear-resistant and generally improved natural turf varieties. These new grass varieties offer improved levels of:<sup>12</sup>

- density and color,
- resistance to cold and heat,
- resistance to drought and disease,
- and shade tolerance.

Artificial turf is susceptible to unevenness, damage, even weeds. But unlike earth and natural grass, which can be changed or corrected relatively easily, repairs to synthetic surfaces are a specialized process that generally require expensive outside contractors.

# Human Health Effects

**MYTH:** *Artificial surfaces can be played on at any time.*

**FACT:** *Temperatures on the surface of artificial turf can sometimes reach more than half again the air temperature causing dangerous burns with water providing cooling only for a limited time.*

## Case study: University of Missouri (M.U.)

Dr. Brad Fresenburg, turfgrass specialist from the University’s Division of Plant Sciences, explains the danger of artificial turf is that the rubber and plastic materials used absorb more of sunlight’s heat energy than natural grass, causing extraordinarily high temperatures. His observations found that on a 98° F (37° C) day, MU’s Faurot Field had a surface temperature of 173° F (78° C). The temperature of the nearby natural grass was only 105° F (41° C). Even at head-level, the temperature over the artificial turf was 138° F (59° C).<sup>13</sup>

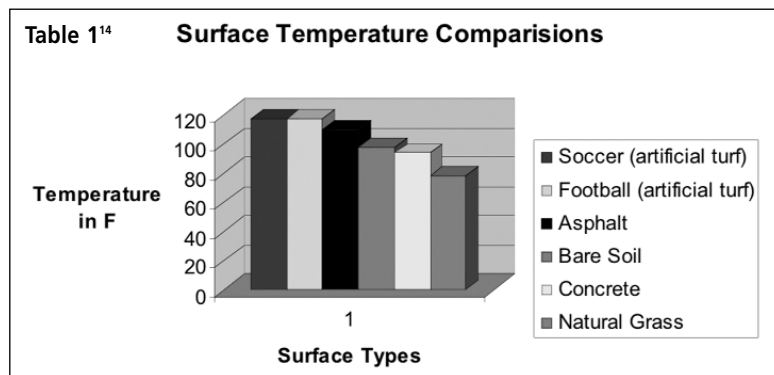
## Case study: Brigham Young University (B.Y.U.)

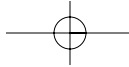
In 2002, Brigham Young University installed artificial turf (FieldTurf™ brand) on one half of its practice field, leaving the other half a sand-based natural turf field. After observing exceedingly hot temperatures from the synthetic turf—including a case where one coach received blisters on his feet through his tennis shoes—Drs. Frank Williams and Gilbert Pulley launched a scientific comparison of the two turf types. For this study, the artificial turf area was examined as two separate fields: the football field and the soccer field.

The Safety Office at BYU has set 120° F (49° C) as the maximum safe temperature that a playing surface can reach, since temperatures of 122° F (50° C) can cause skin injury in less than 10 minutes.

The field study compared not only surface temperatures, but also soil temperatures, temperatures in shade, and the cooling effects of water.

Surface temperatures of playing fields were compared with the temperatures of other common surfaces for perspective:





Human Health Effects

Surface	Average Surface Temperature between 7:00 AM and 7:00 PM
Soccer (artificial turf) . . . . .	117.38° F (47° C) . . . . . high 157° F (69° C)
Football (artificial turf) . . . . .	117.04° F (47° C) . . . . . high 156° F (69° C)
Natural Grass . . . . .	78.19° F (26° C) . . . . . high 88.5° F (31° C)
Concrete . . . . .	94.08° F (34° C)
Asphalt . . . . .	109.62° F (43° C)
Bare Soil . . . . .	98.23° F (37° C)

**Table 2.**

Two inch depth	Average Soil Temperature between 7:00 AM and 7:00 PM
Soccer (artificial turf) . . . . .	95.33° F (35° C) . . . . . high 116° F (47° C)
Football (artificial turf) . . . . .	96.48° F (36° C) . . . high 116.75° F (47° C)
Natural Grass . . . . .	80.42° F (27° C) . . . high 90.75° F (33° C)
Bare Soil . . . . .	90.08° F (32° C)

**Table 3.**

Shade	Average Temperature between 9:00 AM and 2:00 PM
Surface Temperature of Natural Grass . . . . .	66.35° F (19° C) . . . . . high 75° F (24° C)
Surface Temperature of Artificial Turf . . . . .	75.89° F (24° C) . . . . . high 99° F (37° C)
Average Air Temperature . . . . .	81.42° F (27° C)

Other startling observations from the study included:

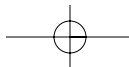
- 200° F (93° C) was the highest surface temperature recorded (on artificial turf) on a 98° F (37° C) day.
- Even during Utah’s cool October weather, the surface of the artificial turf reached 112.4° F (44.7° C)—32.4° F (18° C) higher than the air temperature

When water was used to cool the surfaces of the natural grass and artificial turf, the natural grass remained cool for so long that only the artificial turf’s temperature was recorded at five and 20 minutes after wetting.

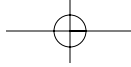
Irrigation cooled the surface of the synthetic field from 174° F (79° C) to 85° F (29° C) but after five minutes the temperature rebounded to 120° F (49° C) (the limit of what BYU considers safe). After 20 minutes, the temperature rose to 164° F (73° C).

**MYTH:** *New rubber-based infill makes artificial turf just as springy and forgiving as natural turf.*

**FACT:** *While new technology has compensated for the hardness of synthetic turf, many injuries are still common due to a lack of ability to yield to pressure.*







## The Science of Traction and Release

Turfgrass specialist Dr. Brad Fresenburg of the University of Missouri Division of Plant Sciences explains that many injuries are due to greater levels of torque, velocity and traction found in conjunction with artificial turf. Dr. Fresenburg performed tests on Missouri's own Faurot Field (made of FieldTurf™) showing that potential pressure on joints and bones is increased from, “the inability of a fully planted cleat-wearing foot to divot or twist out, an action that releases force.”

*“Natural grass has the ability to regenerate or be repaired relatively easily.”*

He noted that while some might see divots or ripped-out grass from natural grass as damage, it is actually a healthy sign indicating that the surface is doing its job of yielding to the athletes' impact, being less likely to cause significant injury. And unlike artificial turf, natural grass has the ability to regenerate or be repaired relatively easily.<sup>15</sup>

## Common Injuries

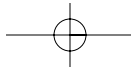
Certain types of injuries are being seen more often due directly to artificial turf and its inherent make-up and inflexibility, including<sup>16</sup>:

- Turf toe (first metatarsophalangeal joint sprain)
- ACL (Anterior Cruciate Ligament) injuries
- Foot lock (caused when the foot is prevented from turning, also placing stress on the knees)
- Concussion
- Turf burn
- Heat exhaustion

**MYTH:** *New-generation artificial turf utilizes sand and rubber-based infill to minimize injuries from skids and falls.*

**FACT:** *The abrasiveness from the sand and rubber impacts sports players in the form of turf burns which open the way to infection.*

Turf burn—part abrasion and part burn—is caused when an athlete's skin slides across artificial turf. These burns happen frequently due to the fact that athletes slide farther on artificial turf due to the lower co-efficient of friction than natural grass, particularly when wet. The sliding action in combination with the friction generates heat which produces the burn, exposing the body to infection.<sup>17</sup>



## Human Health Effects

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**MYTH:** *An artificially created surface is more sterile.*

**FACT:** *The materials used for synthetic turf fields and infill not only carry harmful bacteria, but trap unsanitary body fluids, opening the way for infection; chemicals used for sanitation can create additional problems.*

### Good Bacteria, Bad Bacteria

Different types of bacteria serve different purposes in the world of athletic fields. Soils in natural grass fields contain helpful bacteria which naturally sanitize the surface by decomposing human body fluids, algae and animal excretions. Artificial turf lacks significant populations of these natural cleansers, leaving the job of sanitation to artificial cleansers, which then must be cleaned to leave the surface safe for athletic play. But other bacteria, such as that found in sand and rubber infill of artificial turf, can cause infection and even life-threatening health problems. Because sand and artificial turf has a lower microbiological activity than soil, harmful bacteria do not have to compete with beneficial microbes that grow in turfgrass root zones, allowing the harmful bacteria to multiply to dangerous levels, creating an increased opportunity for dangerous infection. Dr. Brad Fresenburg, turfgrass specialist from the University of Missouri's Division of Plant Sciences, describes how synthetic fields are virtual breeding grounds for harmful bacteria due to the combinations of warmth, moisture, sweat, spit and blood.<sup>18</sup>

### The Life-Threatening Danger of MRSA

In 2003, the Centers for Disease Control (CDC) conducted a study and found that artificial turf was the cause of several cases of Methicillin-resistant Staphylococcus aureus (MRSA) in athletes. MRSA is an antibiotic-resistant bacteria that spreads through contact with people and objects. Symptoms of an infection can begin as seemingly innocuous bumps or nicks in the skin but can quickly spread to the heart, lungs or central nervous system, even capable of causing death.

Researchers found that players who sustained turf burns from artificial turf fields were seven times more likely to contract an MRSA infection since these uncovered wounds allowed the bacteria to pass easily among players in close contact.<sup>19</sup>

### Diagnosis: MRSA

During the 2003 football season, researchers from the CDC found eight cases of MRSA in five members of the St. Louis Rams. Skin scrapings proved that a turf burn from synthetic turf had provided the entry point. MRSA was then passed amongst the players in a variety of ways, such as sharing towels or using locker room facilities that were not completely disinfected. After a game with the San Francisco 49ers, some members of that team were also diagnosed

with MRSA.<sup>20</sup>

MRSA is not a condition limited to the professional sports teams. College and high school players have been diagnosed across the country, including confirmed cases in Connecticut, Texas, Illinois and Pennsylvania.

### **Case study: Sprinturf Finds Bacteria Contamination in Sand Infill**

Following this news, one synthetic turf manufacturer, Sprinturf, has voluntarily started to offer free, life-time decontamination services to existing customers based on the levels of bacteria found in its sand infill. The decision came after independent research commissioned by the company showed infill containing sand had 50,000 times the bacterial count as that of all-rubber infill.

*Athletic Turf News* reported Sprinturf CEO Hank Julicher as being “stunned” by the results of the study but committing to the sanitation techniques which were expected to be needed monthly for each field containing the sand infill. He is also quoted as saying that the synthetic turf company would “strongly encourage others in the industry to do the right thing and follow our lead.”

Because bacteria has become resistant, some common disinfectants used to clean fields, equipment, uniforms and towels don't kill MRSA germs.

### **Case study: China (1960s to today)**

Sadly, history has proven that a lack of natural grass does effect human health and the environment.

During the Cultural Revolution in the People's Republic of China during the 1960s, Chairman Mao and his followers deliberately removed turfgrass and many trees in an attempt to eliminate vestiges of “Western civilization.”

Decades later, the amount of smog and dust in the air has increased, partially because there are an insufficient number of plants to hold down the dust and trap particulate pollutants. As the dust carries disease, bacteria and viruses, the incidences of these illnesses has also risen.

Throughout China today there is a tremendous effort underway to repair the landscape (and the effects on human health) by re-establishing turf and trees. While this hurried replenishment will assist in preventing further damage from being done, lasting health effects on the population have already occurred, and it will take several decades and many generations to counter the affects of what has already taken place.<sup>21</sup>

**MYTH:** *The materials used to create artificial turf are perfectly safe.*

**FACT:** *The rubber and sand used for artificial turf infill are a toxic threat to human health when exposed to heat, impact and other influences.*

## Human Health Effects

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### Toxicity from Rubber

Recycled rubber contains heavy metal substances such as aluminum, cadmium, chromium, copper, iron, magnesium, manganese, molybdenum, selenium, sulfur and zinc, in addition to lead that may have been absorbed into the rubber while in use as an automobile tire. Many of these can be toxic. According to Dr. Linda Chalker-Scott, a horticulturist with Washington State University, "There is no question that toxic substances leach from rubber as it degrades, contaminating the soil, landscape plants and associated aquatic systems."<sup>22</sup>

Some have argued that when old tires are exposed to the elements, they become less harmful; evidence from other studies shows this thought to be incorrect. In one study, it was observed that the materials that leached out of washed, used tires were more toxic to rainbow trout than that from washed new tires.<sup>23</sup> The US Department of Agriculture also found that when recycled tire rubber is used as garden mulch, the zinc from the rubber leaches into the soil, impairing plant growth.<sup>24</sup>

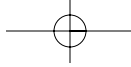
### Breaking It Down

As synthetic fields degrade with use, the materials used break down into smaller and smaller pieces. These tiny microfibers from the field become easily inhaled (particularly during a fall) causing them to enter the players' lungs. Many paints and metals already carry warning labels. How will the dust from these particles effect athletes and maintenance staff? One Massachusetts doctor suggests that the world could be looking at another asbestos curse down the line, complete with lawsuits that could ruin schools or public systems.<sup>25</sup>

The ground rubber used in infill is generally taken from used car tires and a limited portion from tennis shoes. When rubber burns, it releases noxious fumes. A field that catches fire—from either accident or vandalism—becomes a public health hazard.

### The Risk of Silicosis

The sand used for infill also carries the risk of silicosis, a disease first recognized over 400 years ago. Caused by exposure to and inhalation of silica (sand), silicosis causes lung inflammation and even scarring and nodules over long periods of time. There is no known way to reverse the effects and limited treatment options, other than symptom management and prevention of further exposure. Originally silicosis was documented in stonecutters, miners and foundry workers and eventually sandblasters, though with tightened OSHA (Occupational Safety and Health Administration) restrictions requiring respirators, incidence levels have gone down.<sup>26</sup>



According to product warning labels, athletic field workers are instructed not to breathe dust and to use protection when applying silica sand as infill due to the risk of “delayed lung injury.”<sup>27</sup> However, no government organization is involved with the study or restriction of possible sand effects on humans in athletic or even residential settings.

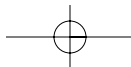
### **Skin and Lung Effects**

A scientific study conducted by Dr. Joseph P. Sullivan on artificial turf found that the tire rubber used for infill could have damaging effects on the human body. He noted that “the most detrimental health effect resulting from direct exposure to tire rubber appears to be either allergic or toxic dermatitis.” Since athletes playing on artificial turf not only come into contact with the rubber but often do so with great force (such as during a fall or tackle), the potential for skin absorption is high. It is estimated that 6% to 12% of the population is allergic to rubber in some form.

Dr. Sullivan also found that “inhalation of components of tire rubber or actual particles of tire rubber can be irritating to the respiratory system and can exacerbate asthma.” Dr. Sullivan cites the basis of these concerns in studies of rubber workers and tire production, noting that these workers have been documented to suffer greater incidence of chronic cough, chronic phlegm, chronic bronchitis, shortness of breath, and tightness in the chest than unexposed workers. Again, the potential for such damaging effects is clear when one considers that athletes spend hours every week stirring up these minute particles while breathing rapidly during the exertion.<sup>28</sup>

### **Potential Cancerous Effects**

Perhaps the most frightening observation noted by Dr. Sullivan is the potential for mutagenic or cancer causing effects when people are exposed to used rubber tire particles. He notes that the exposure of human cells in lab cultures to rubber dust has proven to be toxic, and that not one but three chemicals used in tire production proved positive in tests for mutagenicity, meaning they have the potential to cause human cancer. Dr. Sullivan cites one study’s results where under laboratory conditions, human cells exposed to tire debris organic extract for 72 hours demonstrated a modified physical appearance and an increase in DNA damage.



## *E*nvironmental Health Effects

**MYTH:** *Artificial turf is synthetic, is not tied to the ecosystem and presents no effects on the environment.*

**FACT:** *Artificial turf is a contributing cause of harm to the environment due to run-off and chemicals leached out of the infill.*

Dr. Joseph P. Sullivan found in a study of artificial turf effects that there was great cause for concern regarding the potential environmental impact of crumb rubber. He indicated there may be cases where, due to field drainage, the drinking water's recommended allowable limits might be exceeded; meaning that drinking water polluted with contaminants leached from the rubber becomes unsafe to consume.

In addition, it was pointed out that the culprit may have been polycyclic aromatic hydrocarbons, which are a continuous potential environmental contaminant, regardless of tire age. It is interesting to note that higher levels of organics leached at the higher pH's in lab tests. This suggests that if crumb rubber fields are exposed to alkaline dust (western US) or applied lime for marking, there would be an increased potential of environmental contamination of groundwater or streams with polycyclic aromatics or total petroleum hydrocarbons.<sup>29</sup>

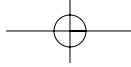
**MYTH:** *Artificial turf is better for the environment because it doesn't require the resources of natural grass.*

**FACT:** *While natural grass requires water and pest control to remain healthy, its resulting benefits to the environment far outweigh those costs.*

### Benefits of Natural Grass

Natural grass helps correct other environmental problems while contributing additional benefits. The benefits of natural grass include:

- Oxygen generation
- Soil erosion control
- Dust stabilization
- Water filtration/purification
- Rain water entrapment for groundwater replenishment
- Flood control/decrease runoff
- Air pollution control
- Enhanced entrapment and biodegradation of synthetic organic compounds
- Reduced Greenhouse gases



- Restoration of disturbed soils
- Urban heat dissipation/temperature reduction
- Noise abatement
- Glare reduction
- Reduced smog pollution
- Eliminates hiding places for ticks, snakes and other potentially noxious pests
- Decreased allergy-related pollens
- Fire prevention (grassed firebreaks)

### Case study: China

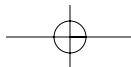
When China stripped away turfgrass and trees forty years ago, the effects to the environment were both immediate and lasting.

The lack of shade trees and turf caused cities to become “heat islands,” where temperatures are 10° F (5.6° C) to 30° F (16.7° C) hotter than outlying rural areas. Air pollution from dust and smog increased due to a lack of turfgrass to trap these materials. The lack of turf also increased erosion, raising levels of pollution and damaging water quality in ponds, streams, rivers and lakes.

While Chinese leaders are now working with Westerners to restore the landscapes that were once taken away, it will take decades to re-establish an environmental balance.

### Did You Know?

- A typical lawn (2,500 sq. ft./232 m<sup>2</sup>) converts enough carbon dioxide from the atmosphere to provide adequate oxygen for a family of four.
- The front lawns of eight houses have the cooling effect of about 70 tons of air conditioning; the average home’s air conditioner has only a three or four ton capacity.
- A healthy, sodded lawn absorbs rainfall six times more effectively than a wheat field and four times better than a hay field.
- One acre of grass produces more oxygen per year than one acre of rainforest.



## Mental & Emotional Impact

**MYTH:** *Professional sports players, coaches and fans prefer artificial turf.*

**FACT:** *From football to baseball to soccer, those involved with pro sports prefer natural grass not only for its consistency for bounce and roll of a ball but also for the more forgiving effects on the human body.*

### Case study: the NFL Players Association

In 2004, the NFL Players Association conducted a survey of more than 1500 players from all 32 teams. The results clearly showed that the majority of football players not only prefer natural turf as a playing surface but also have a deep distrust of artificial surfaces. The facts revealed in the survey include:

- 96% of NFL players believe that artificial turf causes more soreness and fatigue than natural grass.
- 91% feel that artificial turf is more likely to contribute to injury than natural grass.
- 87% feel that artificial turf is more likely to affect a player's quality of life after football.
- 85% feel that artificial turf is more likely to shorten a player's career.
- More than 1/3 of players feel they've had at least one injury caused by artificial turf that would not have occurred on natural turf.
- 85% of players prefer to play on natural grass.

When players were asked to rank the best and worst playing fields in the league, results showed that the top four fields all had natural turf while seven of the worst ten fields contained artificial turf (either AstroTurf<sup>®</sup> or FieldTurf<sup>™</sup>).

### In Their Own Words...

The following quotes are from various sports professionals, including coaches, players, parents and managers, in regards to artificial playing surfaces:

*"In the majors, we used to dread going on the road to play on an artificial field. There's no way I would consider one for my kids. Baseball was meant to be played on grass."*

—Bret Saberhagen, head baseball coach at Calabasas, California high school

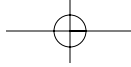
*"We haven't been able to convince the top international teams to play on anything but grass. So on three separate occasions, we've [had]... to create a grass field over our existing in-fill surface."<sup>30</sup>*

—Mike McFaul, First and Goal, Inc. (parent company of Seattle's Qwest Field)

*"I've never been a fan of artificial surfaces. A guy makes a good pitch and the ball squirts through a hole – that's not baseball."<sup>32</sup>*

—Willie Randolph, Manager, New York Mets





*“When you dive, your glove should not stick on the ground. You can’t simulate grass. No matter what you do, you can’t fake it... [Artificial turf] has hard spots, soft spots, sometimes your cleats stick to it, and sometimes you slip. It’s not good to play on.”<sup>31</sup>*

—Troy Glaus, while playing with the Minnesota Twins

*“This artificial grass was a disaster. It hurt my feet. I really hope we don’t get this in the Amsterdam Arena. If this is the future, I’d better stop playing football (soccer).”<sup>33</sup>*

—Rafael van der Vaart, former soccer player for Ajax Amsterdam, The Netherlands

**MYTH:** *Artificial turf is just as good as natural grass in every way.*

**FACT:** *Although no related research on artificial turf is currently available, studies have shown that natural grass has a positive emotional, as well as visual, impact on humans.*

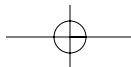
## The Joy of Grass

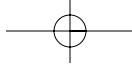
A few facts about the emotional influence of natural grass include:

- Studies have shown that hospital patients with a view to a natural green space recover faster. New health care facilities are being constructed with outdoor gardens and more indoor greenery.
- Large cities with urban neighborhoods are placing an emphasis on neighborhood parks, which have been shown to reduce crime as well as increase positive community feelings.
- Home values rise when natural grass and landscaping is improved.

Drs. James B. Beard and Robert L. Green published a study in the *Journal of Environmental Quality* in 1994 describing the benefits of natural turfgrasses. The aesthetic benefits they list include<sup>34</sup>:

- Enhanced beauty and attractiveness
- A complimentary relationship to the total landscape ecosystem of flowers, shrubs and trees
- Improved mental health with a positive therapeutic impact, social harmony and stability
- Improved work productivity
- An overall better quality-of-life, especially in densely populated urban areas.





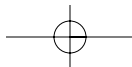
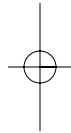
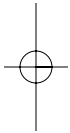
## *C*hoosing Your Future

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**D**espite our advances in science, no kind of artificial turf can effectively replace natural grass.

The frightening effects of artificial turf on both humans and the environment are already being corrected by natural grass on a daily basis. Athletes and coaches, professionals and amateurs, fans and homeowners all prefer the joy that natural grass brings into their lives. The cost(s) of installing and maintaining a natural grass field provides a far better short- and long-term value than the costs of artificial turf, especially when considering wear and lifespan.

Natural grass is a vital part of a balanced environment, one that future generations should be allowed to enjoy and benefit from as much as we have.



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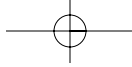
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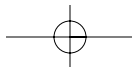
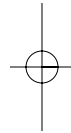
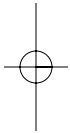
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- <sup>16</sup> “Why choose natural turf? A discussion on natural versus artificial turf for sport and leisure applications” by the European Seed Association, 2006.
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## Facts About Artificial Turf and Natural Grass

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