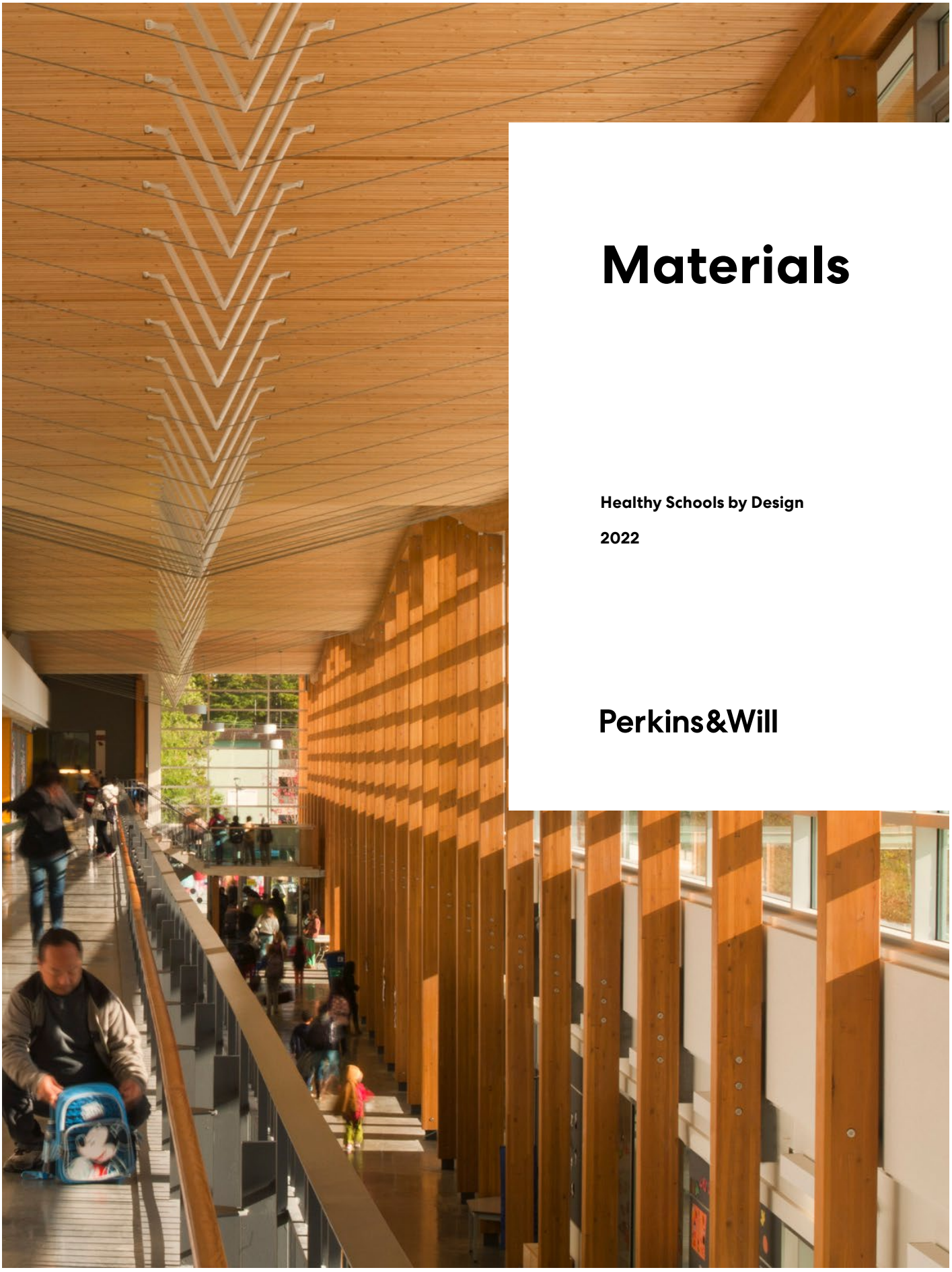
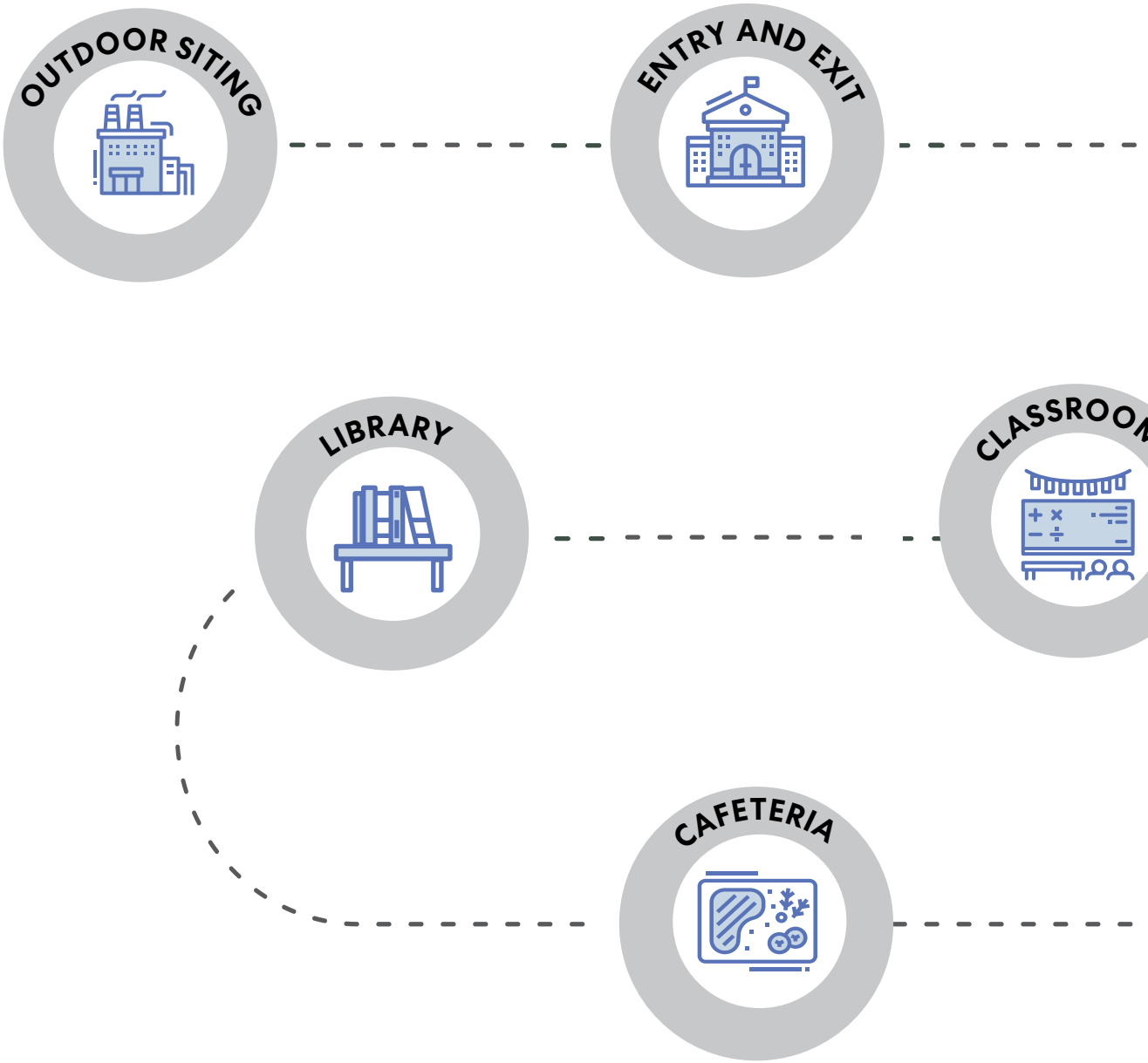


Materials

Healthy Schools by Design

2022

Perkins&Will

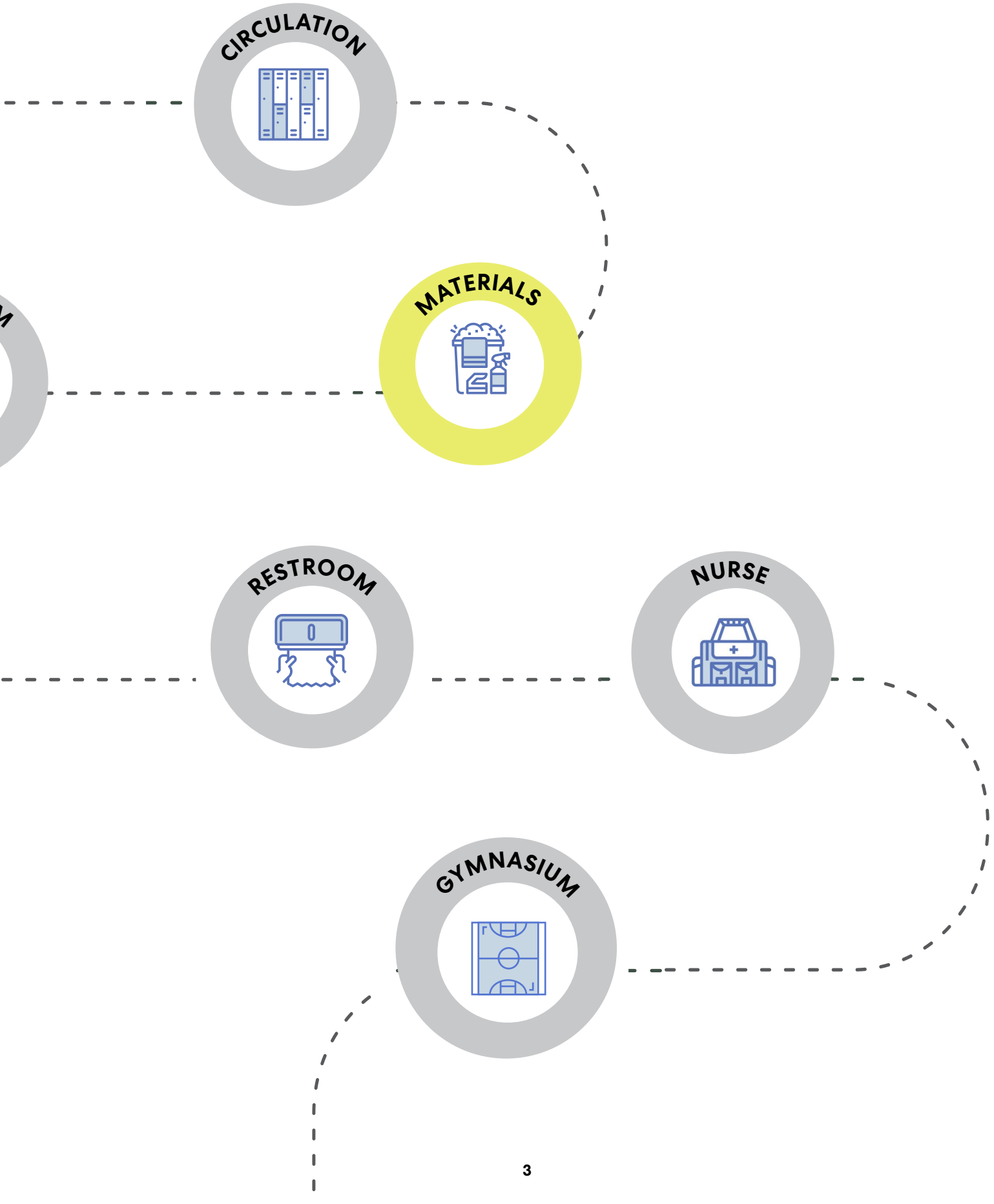


A DAY IN THE LIFE

Meet Riley

In the pages that follow, we invite you to imagine how these design interventions will impact Riley, an imaginary—but very real—student. We owe it to students like Riley to make school buildings as inviting, safe, and healthy as they can be.

Follow Riley's journey through school at
healthyk12.perkinswill.com/


CIRCULATION
MATERIALS
RESTROOM
NURSE
GYMNASIUM

Why you should read this!

- **90% of school occupants are rapidly developing children and women of reproductive age**, who are highly sensitive to an increasing number of chemicals that bioaccumulate in our bodies.
- **Certain phthalates, seen in plastics in building materials, can impair brain development** in childhood and have adverse effects on the reproductive system, especially in boys (Engel et al., 2021).
- **Careful material selection can also dampen background noise** that distracts learners and causes teachers' vocal strain.
- Material selections should prioritize maintenance and operations because the **long-term impact of adverse exposure can significantly affect teachers, students, and staff.**
- **The poorest communities often have older buildings**, and may be exposed to cheaper, unhealthy material alternatives that compound existing health burdens.

Our Goal

This series is focused on translating research into practical design solutions that promote health in our K-12 schools. The guidance provided is based on the available information as of the date of publication and does not replace federal, state, or local public health recommendations. It aggregates best practices and innovative solutions at the intersection of buildings and school health. We encourage schools to reach out and seek expert advice on their unique circumstances.

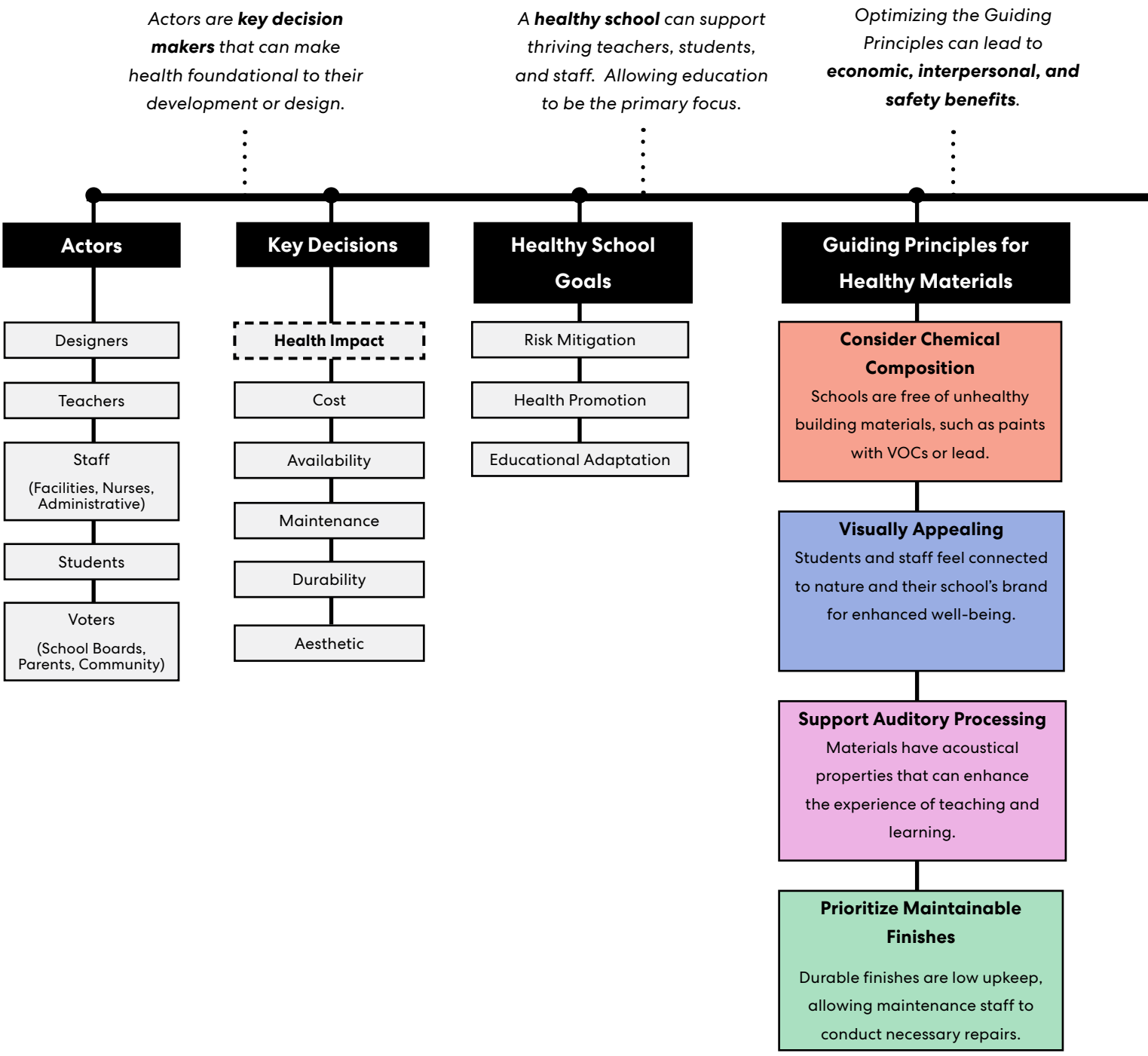
Project: Lisle Elementary School

Contents

— Materials

Design is an essential part of creating a healthy school, especially when children spend 15,000 hours in their schools before they graduate 12th grade. From the cells in your body to a sense of belonging, building materials can impact your health and well-being. The strategies outlined in this document call attention to the materials found within our schools, including harmful chemical additives that migrate out into the air and dust we breathe.

The Impact of Healthy Materials in Schools



Materials

These mechanisms support ***emotional, physiological and psychological health improvements***

Mechanisms

Chemical Composition

Reduce substances of concern to ensure student and staff safety.

Biophilic Design

Introduce nature through biophilic design to improve student and staff well-being.

Color

Apply color relative to student activity and level of focus.

Acoustical Dampening

Balance reflective and absorptive surfaces to maximize speech intelligibility.

Health Outcomes

Improved psychological outcomes, including reduced loneliness and increased feelings of inclusion.

Improved respiratory health and lower asthma rates.

Reduced exposure to developmental toxicants and carcinogens.

Lowered stress levels.

Reduced noise-related distractions.

Increased speech clarity for better learning.

Reduced exposure to harsh cleaners and chemicals.

Check it out!

Healthy can be cost effective!

When selecting materials, durability, cost, and availability are the main decision drivers. However, the immediate and long-term consequences of material selection, require a more holistic decision-making approach that accounts for costs associated with school occupant health and illness.

Physical Design

You may already be aware of the unhealthy building materials in your school.

It is often the case that as older buildings deteriorate, they increase student and staff exposure to harmful substances that have carcinogenic and neurotoxic properties. This can include lead in chipping paint or drinking water, asbestos from insulation or tiles, Polychlorinated Biphenyls (PCBs) in light ballasts and peeling caulk, or mercury in lighting.

ANTIMICROBIALS are persistent, bioaccumulative, and toxic chemicals that can be used to kill or prevent the spread of harmful microbes (Coffin, Lent, Sabella, et. al, 2017). The overuse or misuse may lead to antibiotic resistant microbes (WHO, 2021).

Found in:

- **Countertop paints**
- **Door hardware**
- **Stains**
- **Sealants**
- **Adhesives**
- **Ceiling tiles**
- **Wood products**
- **Grouts**
- **Textiles**
- **Upholstery and fabrics**
- **Ceramic tile**
- **Countertops**
- **Carpets**
- **Disinfection products**
- **Wallpaper and wallcoverings**

Health impacts to children: neurotoxicant, carcinogenic, developmental toxicant, respiratory sensitization, asthmagen, mutagen, eye and skin irritation, skin sensitization, endocrine disruptor, organ toxicant.

BISPHENOLS are a persistent substance that accumulates in the body and found in many plastic products. A common bisphenol is BPA.

Found in:

- **Cabinets**
- **Countertops**
- **Epoxy resins**
- **Paints**
- **Flooring**
- **Floor sealants**
- **Protective coatings**
- **Consumer products**
- **Polycarbonate plastics (Bradman, et. al, 2017).**

Health impacts to children: Bisphenols are an endocrine disrupting chemical that can have adverse impacts on a child's reproductive health, neurodevelopment and behavior, and increase their risk for type 2 diabetes, obesity and cardiovascular disease (Braun, Hauser, 2011).

FORMALDEHYDE has been found in high concentrations in schools (Bradman, et al. 2017). Children are at heightened risk because their bodies are still developing, are smaller, and closer to the floor where exposure can occur (PEHSU, 2016).

Found in:

- **Furniture**
- **Insulation**
- **Acoustical ceiling panels**
- **Adhesives**
- **Cabinets**
- **Exterior wood flooring and paneling**
- **Countertops**
- **Woodwork/Carpentry**

Health impacts to children: carcinogenic, eye and skin irritation, skin sensitization, menstrual disorders, asthma exacerbation (PEHSU, 2016).

ISOCYANATES are a low molecular weight chemical found in flexible substances. There wide use in building materials makes them one of the most common asthmagens.

Found in:

- **Polyurethane foams**
- **Coatings**
- **Resins**
- **Adhesives**
- **Composite wood**
- **Varnishes**
- **Paints**
- **Replacements for formaldehyde**
- **Sealants**

Health impacts to children: Isocyanates are classified as potential human carcinogens and can lead to irritation of skin and mucous membranes, asthma exacerbation (Krone, Klinger, 2005), chest tightness, and difficulty breathing (OSHA, 2021).

PERFLUOROALKYL SUBSTANCESare a large, complex, and ever-expanding group of manufactured chemicals that are widely used to make various types of everyday products.

Found in:

- **Stain-repellent and waterproof coatings on carpets**
- **Furniture upholstery**
- **Wall paints**
- **Sealants on countertops and tiles**
- **Coatings on hardwood floors**

Health impacts to children: Decreased vaccine response in children (ATSDR, 2021), negative developmental and behavioral outcomes

VOLATILE ORGANIC COMPOUNDS (VOCs)include a major group of indoor and outdoor air pollutants, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. Long term exposure to organic pollutants, both inside and outside school buildings may affect children's health and influence their learning performance (Nitika et al., 2015).

Found in:

- **Paints**
- **Wood preservatives**
- **Cleansers and disinfectants**
- **Air fresheners**
- **Hobby supplies**
- **Pesticide**
- **Building materials and furnishings**
- **Office equipment, such as copiers and printers**
- **Craft materials, such as glues and adhesives**
- **Permanent markers**

Health impacts to children: The immediate symptoms of being exposed to volatile organic compounds (VOCs) include, eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment.

Introduction

Project: *North Kansas City School District, SAGE*

VISUAL

The appearance of materials can have an impact on our brains. Material selections that mimic nature, increase exposure to natural light, and elicit emotions through color can help to support increased well-being.

Biophilic Design

In a world where 25.1 percent of our students have anxiety, school design needs to support positive mental, physical, and social outcomes (Wang et al., 2017). Biophilic design has the potential to improve student wellbeing by encouraging positive attitudes, reducing stress, and decreasing mental fatigue (Allen et al., 2020). Thoughtful biophilic intervention can support SEL readiness, increasing students' ability to self-reflect, set goals, build empathy & relationships, and make responsible and caring decisions (Kellert, 2005).

Reflectivity of Daylight

Studies show a positive correlation between daylight and student performance (Baloch et al, 2020). Daylight and natural views synchronize the body's natural circadian rhythm, thus influencing mood, alertness, and concentration. To maximize the amount of daylight in a room, light colored surfaces should be selected. These light surfaces bounce additional light deeper into the room (Leslie, 2010).

Color

Research shows us that learning is enhanced when multiple senses are stimulated (Willis, 2007). Color can help keep students activated when incorporated appropriately so as not to overwhelm. Less saturated, but bright colors have been shown to boost mental energy. Color can be incorporated in a variety of ways, including paint and graphics.

AUDITORY

Acoustical Dampening

Reverberation time is an acoustical measurement for how long sound lasts inside a room, which depends on the size of the room and the surface finishes within. The addition of "soft" materials such as acoustical ceiling tiles or sound absorbing wall panels can reduce reverberation time for an enhanced auditory experience, while carpet flooring is better suited to muffle noise while students and furniture are moving around. Depending on the use and scale of a teaching space, sound energy coming from the teacher's voice will require a balance of both reflective and absorptive surfaces to maintain appropriate speech intelligibility for student learning (Aytar et al., 2003).

MAINTENANCE

Consideration of material selection also includes durability and maintenance. Finishes and materials that can be easily cleaned and maintained (non-porous) improve longevity, prevent the need for harsh chemical cleaners, and lower costs of maintenance and replacement. Integrated pest management and green cleaning products reduce toxic exposures, reduce asthma exacerbations, increase safety for staff and students, and save money for the district. Stackable, easy to move furniture provides opportunities for diverse learning pedagogies, easy cleaning for custodial staff, and customizable spaces for teachers.

Strategies —— Guiding Principles Legend:

Consider Chemical Composition *Visually Appealing* *Support Auditory Processing* *Prioritize Maintainable Finishes*

	STRATEGY	CATEGORY	NEW/EXISTING	IN YOUR SCHOOL?
M.1	Use a **multi-faceted integrated pest management** approach to reduce routine exposure to chemical cleaners. (Brenner et al. 2003; NIOSH, 2007; U.S. EPA, 2021).	**Risk Mitigation** **Health Promotion** Educational Adaptation	**New Construction** **Existing Building**	**O Yes** **O No** **O Not Applicable**
M.2	Select **hard, non-porous furnishings** that will respond well to green cleaning products such as, **Green Seal™**, the EPA's Design for the Environment, Environmental Choice's EcoLogo and the European Union's Ecolabel. (Regional Asthma Management & Prevention)	**Risk Mitigation** **Health Promotion** Educational Adaptation	**New Construction** Existing Building	**O Yes** **O No** **O Not Applicable**
M.3	Buy **EPA-approved cleaners and disinfectants in bulk** that are effective on bacterial, viral, and fungal infections. Do not mix cleaners to prevent creation of harmful secondary pollutants. (U.S. EPA, 2021) (American Lung Association, 2020)	**Risk Mitigation** **Health Promotion** Educational Adaptation	**New Construction** **Existing Building**	**O Yes** **O No** **O Not Applicable**
M.4	Select **natural patterns and finishes** in flooring, wall, acoustical paneling to create biophilic spaces to lower student stress and higher student enjoyment. (Determan et al. 2019)	**Risk Mitigation** **Health Promotion** Educational Adaptation	**New Construction** **Existing Building**	**O Yes** **O No** **O Not Applicable**
M.5	Incorporate **acoustic surfaces to minimize reverberation time** for improved speech intelligibility.	Risk Mitigation Health Promotion **Educational Adaptation**	**New Construction** Existing Building	**O Yes** **O No** **O Not Applicable**
M.6	Include **flexible, stackable, easy to move furniture to make cleaning easier and support diversified learning.**	Risk Mitigation **Health Promotion** **Educational Adaptation**	**New Construction** **Existing Building**	**O Yes** **O No** **O Not Applicable**
M.7	Select or replace furniture and materials to ensure they are **without chemical additives** (flame retardants, stain repellents, phthalates). (Eitland et al. 2017)	**Risk Mitigation** **Health Promotion** Educational Adaptation	**New Construction** **Existing Building**	**O Yes** **O No** **O Not Applicable**
M.8	Incorporate color and school branding through **low VOC paint and graphics.**	Risk Mitigation **Health Promotion** **Educational Adaptation**	**New Construction** **Existing Building**	**O Yes** **O No** **O Not Applicable**
M.9	Selecting finishes and furnishings with **light colored surfaces can maximize daylight** reflected into the space. Consider placement in relation to windows to avoid introduction of glare.	Risk Mitigation **Health Promotion** **Educational Adaptation**	**New Construction** Existing Building	**O Yes** **O No** **O Not Applicable**

Our aim is to support holistically healthy buildings, but we understand that each learning community is unique and has their own health priorities. Use these strategies as a starting point!

Snapshot: Making the Healthier Decision

	LINOLEUM	RUBBER	LVT	VCT
Initial Cost/SF	$$$	$$$	$$-$$$	$
Warranty	30 years	15 years	15 years	5 years
Bacteria Resistant	✓			
Developmental Toxicity*			⚠	⚠
Carcinogens*		⚠	⚠	⚠
Asthmagen*			⚠	⚠

** Evaluation based on substances most commonly present in the given product type via HBN Pharos contributing 2% or more of the product composition, listed according to the Greenscreen for Safer Chemicals methodology and associated hazard levels.*

*** Full assessment of topcoat content required to avoid potential human hazards. Avoid added substances of concern found in this document.*

⚠ *Substances present in the final product meet authoritative hazard lists and are identified as a direct health hazard to humans.*

⚠ *Substances used to make these products meet authoritative hazard lists and are identified as a direct health hazard to humans.*

✓ *Bacterial resistance is inherent through the natural properties of the flooring and not chemical additives.*

Materials

Strategies in Action

M.8

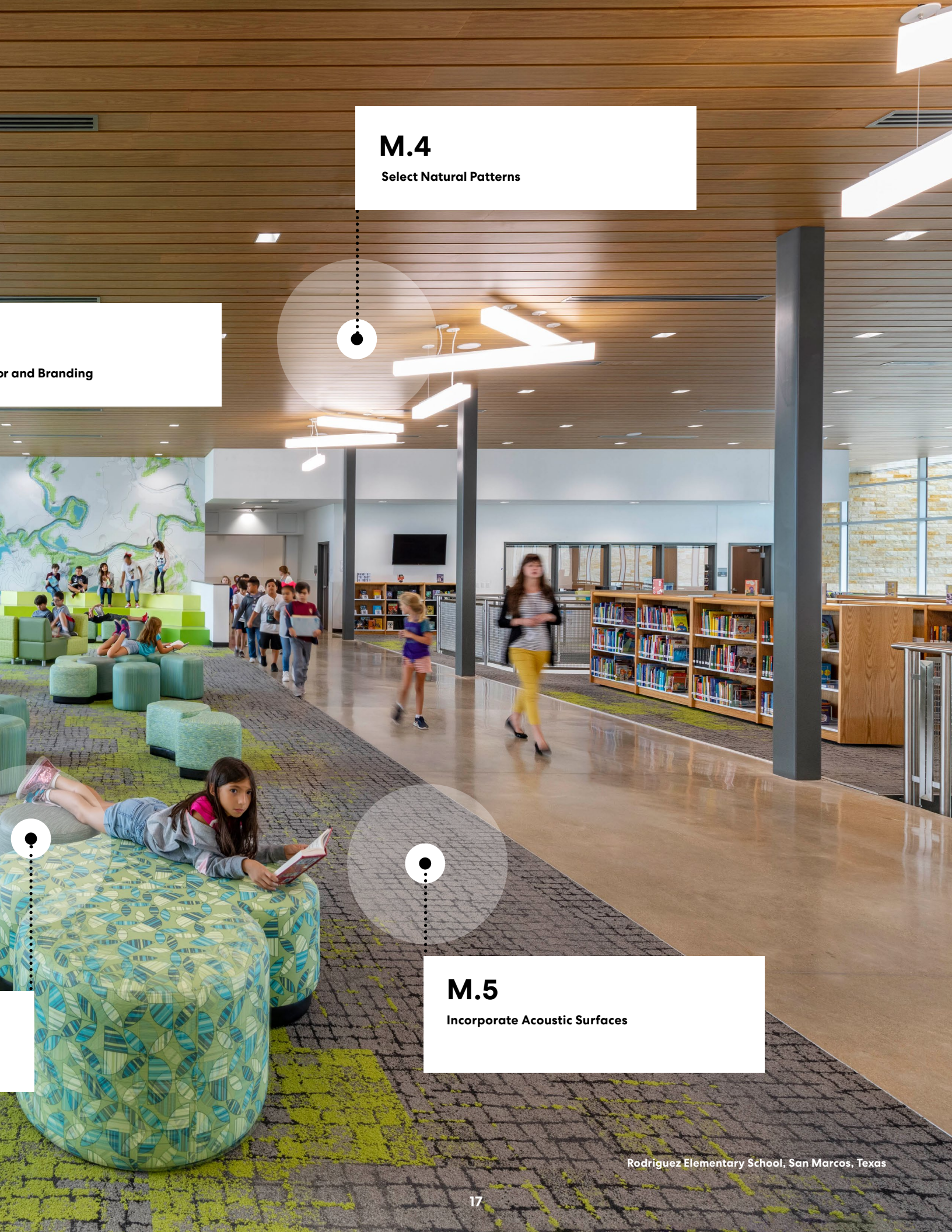
Incorporate Colo

M.9

Select Light Colored Surfaces to Reflect Daylight

M.6

Select Flexible, Easy to Move Furniture



M.4

Select Natural Patterns

or and Branding

M.5

Incorporate Acoustic Surfaces

Rodriguez Elementary School, San Marcos, Texas

Tools for Healthier Materials

Our team compiled a series of guidelines, assessments, websites for working experts' reference

Perkins&Will Transparency Tool

It is important to have a general overview of common products used in schools and how their chemistry can affect human health. From ceiling tile to vinyl flooring you can find the "nutrition facts" of your design decisions

Guiding Principles:

Furniture & Carpets Fact Sheet

Want specific insights? We recommend checking out the Furniture & Carpets fact sheet from the Children's Environmental Health Network (CEHN). Also, available in Spanish.

Guiding Principles:

Center for Green Schools

Center for Green Schools at U.S. Green Building Council provide the tools to make healthier decisions in the policy guidebook, Healthy Green Purchasing for Asthma Prevention that helps schools select environmentally friendly products.

Guiding Principles:

HomeFree

This national initiative and available educational resources raises awareness about toxic building materials and associated health hazards. It teaches affordable housing practitioners to make informed decisions and select healthier building materials. The website provides specific guidance on products (e.g., flooring, paint, insulation), case studies, educational materials, and other actionable resources.

Guiding Principles:

Myth Busted

The healthy option is not always the most costly option.

Let's look at one of the most common healthy materials decisions in our schools -- flooring. With the greatest square footage, an entire generation of students will touch this surface until its replacement every 15-25 years. For areas like administrative offices and media centers, carpeting may be more common, but this is an opportunity to think about the use of harmful adhesives, fibers, and additive stain repelling chemicals. This example provides an opportunity to make a healthier choice without significantly breaking the budget.

Guiding Principles Legend:

Consider Chemical Composition *Visually Appealing* *Support Auditory Processing* *Prioritize Maintainable Finishes*

Furniture is Part of the Solution

Furniture should be part of the healthy materials conversation!

Poor posture in children is associated with discomfort (Breen, Pyper, Rusk, Dockrell, 2007) that may impact focus or attention. **It has been shown that students with flexible seating options that allow them to wobble, rock, bounce, lean or stand can increase oxygen flow to the brain, while movement in the classroom has been associated with improvements of on-task behavior** (Mahar, et al. 2006). However, flexible furniture may create challenges when completing individual tasks, social distancing, or finding replacement parts (Klein, 2020).. A diversity of spaces and learning environments can create a welcoming, more inclusive space for all students while giving them self-efficacy to make decisions on where is best to learn for them.

Project: Rodriguez Elementary School

Understanding Past Material Selections

Flame Retardants

When did you last buy cushioned, upholstered furniture?

If it was prior to 2014, they most likely includes flame retardants, a chemical additive added between 1975-2014 to reduce flammability, but can migrate out of older furniture as it is used and deteriorates. **Because flame retardant chemicals are not covalently bonded to fabrics and upholstery foam, they can migrate into the air and dust children breathe.** These chemicals have been linked to negative health effects, including hormone disruption, impaired brain development, liver damage and cancer. (NIEHS, 2016).

Does your school still have flame retardant chemicals?

- **Flip over an office chair or sofa cushion**
- **Look for the Technical Bulletin 117 or TB 117 label**
- **Look for the notice regarding flammability requirements**

Project: Ryan Middle School

Example: Furniture Flammability Warning

WORST

NOTICE

This article meets the flammability requirements of California bureau of electronic and appliance repair, home furnishings and thermal insulation technical bulletin 117. Care should be exercised near open flame or with burning cigarettes.

Furniture made from 1974 - 2014 may have the "Technical Bulletin 117"or "TB 117" label ONLY.

The product almost certainly contains flame retardant chemicals.

BEST

NOTICE

This article meets the flammability requirements of California bureau of electronic and appliance repair, home furnishings and thermal insulation technical bulletin 117-2013. Care should be exercised near open flame or with burning cigarettes.

The upholstery materials in this product:

___contain added flame retardant chemicals

_X_contain NO added flame retardant chemicals

The State of California has updated the flammability standard and determined the fire safety requirements for this product can be met without adding flame retardant chemicals. The State has identified many flame retardant chemicals as being known to, or strongly suspected of, adversely impacting human health or development.

Furniture made after January 1, 2015 will have "The Technical Bulletin 117-2013" label AND the new flame retardant label.

Look for the labels marked "contain NO added flame retardant chemicals".

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For more information, contact:

K12Education@perkinswill.com

Continue Riley's journey at:

healthyk12.perkinswill.com/

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