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HUMAN HEALTH & WELLNESS IN

THE BUILT ENVIRONMENT

What You Need to Know about the Well Living Lab

AN EXPERT INTERVIEW WITH DR. BRENT BAUER

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HUMAN HEALTH & WELLNESS IN THE BUILT ENVIRONMENT:

WHAT YOU NEED TO KNOW ABOUT THE WELL LIVING LAB

with

DR. BRENT A. BAUER, MD

ABOUT **DR. BRENT A. BAUER, MD**

REASEARCH DIRECTOR, INTEGRATIVE MEDICINE AND HEALTH PROGRAM, MAYO CLINIC

Dr. Bauer is board-certified in Internal Medicine, a Professor of Medicine and has been on staff at Mayo Clinic for 24 years. His main research interest has been the scientific evaluation of Complementary and Alternative Medicine (CAM) therapies that patients and consumers are using with increasing frequency. He has authored several book chapters and over 100 papers on this topic, and is the Medical Editor of the Mayo Clinic Book of Alternative Medicine and The Science of Integrative Medicine, a Great Courses video series. He is also the founder of the Integrative Medicine and Health Program at Mayo Clinic. He is a member of numerous scientific review panels and is currently collaborating on over 20 studies being conducted at Mayo Clinic evaluating CAM therapies ranging from acupuncture to valerian. He is the Medical Director of Rejuvenate, the first spa at Mayo Clinic. He is also the Medical Director of the Well Living Lab, a collaboration between Delos and Mayo Clinic Center for Innovation, which is exploring the impact of the indoor environment on wellness. His work is at the forefront of the emerging field of Integrative Medicine which combines the best of conventional medicine with the best of evidence-based complementary therapies.

ABOUT **THE WELL LIVING LAB**

The Well Living Lab is the first scientific research center that uses exclusively human-centered research to understand the interaction between health and well-being and indoor environments. The Well Living Lab offers an unprecedented degree of control over research variables through a modular, reconfigurable space that simulates a wide variety of real-world environments. The Lab brings together the health care expertise and world-class research of Mayo Clinic and the knowledge of health and wellness in the built environment provided by Delos. This world-class research approach leverages and expands upon the principles of the WELL Building Standard™, which focuses on seven Concepts relevant to indoor health—air, water, nourishment, light, fitness, comfort and mind.

ABOUT **RYAN PICARELLA, MS, SPHR**

As President of WELCOA, Ryan works with communities and organizations around the country to ignite social movements that will improve the lives of all working people in America and around the world. With a deep interest in culture and sociology, Ryan approaches initiatives from a holistic perspective that recognizes the many paths to well-being that must be in alignment for long-term healthy lifestyle behavior change. Ryan brings immense knowledge and insight to WELCOA from his background in psychology and a career that spans human resources, organizational development and wellness program and product design. Prior to joining WELCOA, Ryan managed the award winning BlueCross BlueShield of Tennessee (BCBST) Well@Work employee wellness program, a 2012 C. Everett Koop honorable mention awardee. Since relocating to Nebraska, Ryan has enjoyed an active role in the community, currently serving on the Board for the Gretchen Swanson Center for Nutrition in Omaha. Ryan has a Master of Science in Industrial and Organizational Psychology from the University of Tennessee at Chattanooga and a Bachelor of Science in Psychology from Northern Arizona University.

What you need to know about the Well Living Lab: Light, air, and noise impact health, and the aim of the Well Living Lab is to find out how. A smart team of scientists and researchers are working right now to create smarter spaces and healthier employees. WELCOA sits down with Dr. Brent Bauer from the Mayo Clinic to learn more about the project.

RYAN PICARELLA I have been very excited about this interview and the great work that you guys been doing at the Well Living Lab at Mayo. To start, I'd love for you to talk about where the Well Living Lab emerged from and how you first started down this path at Mayo Clinic?

DR. BAUER One of the critical points is that Mayo has been very focused on the concept of wellness really from the start, and if you go back to some of our founders' quotes and aphorisms, you'll find a great emphasis on the importance of promoting health and wellness through lifestyle, through nutrition and so forth. So I think we have always had a strong focus on wellness, but I think it has really been in the last two decades where we have been more strategic about putting that front and center. Part of where my interest in this realm comes from is my creation of the Integrative Medicine program here at Mayo Clinic about 15 years ago to focus on some of these things that touch on wellness but are not normally part of conventional medical approaches.

So we have created a large acupuncture program, meditation program and a very large mind-body program, because obviously as you know from your work; stress is probably one of the most prevalent and one of the most damaging problems people face, whether it is in their personal lives or work lives—wherever. So my interest in wellness really sprung from finding ways to incorporate evidence-based approaches that have not always been at the table. With that background, about three or four years ago, Delos came to the Mayo Center for Innovation with the proposal that they knew something about the built environment. They asked if we recognized that we spend ninety percent of our time indoors, and if we spent ninety percent of our time indoors than it is probably pretty important to focus on what happens in the indoor environment as a determinant of health.

So that is really where the lightbulb went off—at least in my head—because I never really thought of it from that perspective before. But if you think about when you go to bed and wake up and get in your car and come to your workplace and get in your car and go back to your place, we are pretty much indoors most the time. So then it is kind of hard to refute the idea that what is going on in the indoor environment is pretty important. What Delos did is a long time ago was to develop the Well Building Standard™, which really sets the stage for how we make these indoor environments healthy. They have developed the WELL Building Standard based on scientific principles for sound, for air quality, for light, for ergonomics, for comfort but also for things like mind, stress, nutrition and so forth.

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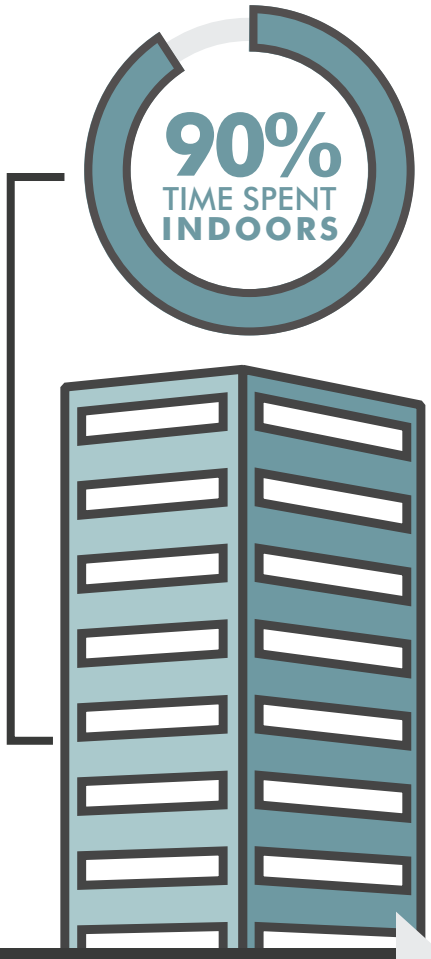

The Well Living Lab really joins Delos' knowledge of building science and future opportunities in their industry with the medical science that Mayo is known for. If we could bring those two together, couldn't we really solve a lot of the questions that companies, employers, employees, also homeowners, hotel operators need to know about what to invest in? What should I put in my house? What kind of filter should I use? Should I use a standing desk? So as you think of all this great interest in wellness, there is almost too much to choose from and we have limited resources, at least most of us do. So I think somebody has to step into the breach and help people make that decision.

So the building science meeting the medical science led to the idea that we should start by creating a laboratory, a highly configurable laboratory, so that we could model real-world environments of hotel rooms, bedrooms, apartments, offices, open offices, closed offices and make them highly sensor rich so we can evaluate all aspects of the environment. The goal is for participants, though, not to recognize it as a lab but really have it feel like a workplace, a bedroom, an apartment, have them wear very minimal devices, perhaps a Microsoft band or a Fitbit. But we still gather lots of biometric data from human participants and then put that data together with what we learn from the environment and then really try to answer those hard questions about how we optimize indoor environment. What are the things we should do and invest our resources on to make us all healthier?

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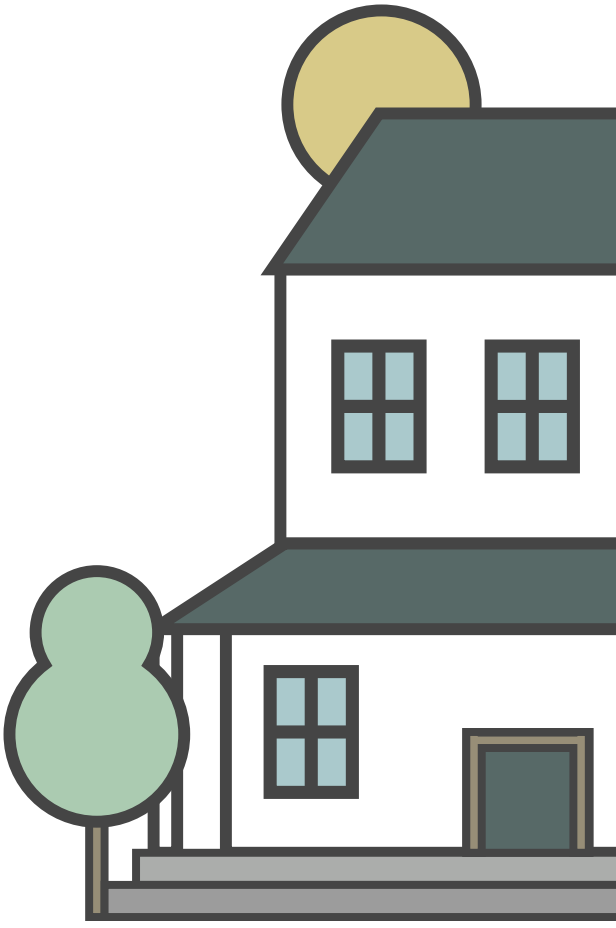
RP Could you put a percentage on how much the built environment impacts health? Would you say that there is any kind of number out there for how it impacts us since we are in it ninety percent of the time?

DR. BAUER If you spend ninety percent of your time doing something, that is probably going to have a pretty big impact on you. Think about things we do not typically consider; I personally did not think much about things like particulate matter, VOCs, carbon dioxide levels—certainly not 20 or 30 years ago. But I think all of us are starting to understand more about the air quality. What does it mean when our new carpet off-gases? What are the new car smells? Are those gasses dangerous?

RP It is unbelievable—that new car smell. It might not be so sweet when we know exactly what it is?

DR. BAUER We know that there are some things, the off-gas from the different products in a car. The question is *what level is safe*? If there is some concern, what is the best way to mitigate that? Is it a filtration system? Is it keeping the windows open? I think those are the types of questions that can be answered scientifically when you pair the best building science with the best medical science. I think we are going to be able answer a lot of questions to help people make informed decisions. Again, we are still humans so even if we optimize our environment, we still have to deal with human choices and human behaviors, and



even that can be influenced by your environment. We can create workstations that make us more likely to move about as opposed to being locked motionless for eight hours in front of a computer. So I think even as we get into some of the messier aspects of health where human choices and human habits are going to play a big role, even then the environment is going to be important because the environment can either move us towards good habits or move us away from good habits.

RP You have mentioned a couple of variables like particulates in the air and light in the room, and I know that Delos is interested in seven dimensions for their standard. Are you starting with a certain core set of variables that you are measuring the impact of?

DR. BAUER The very first experiment is going to focus primarily on light, sound and acoustics, and temperature because those are fairly hard endpoints. We have good sensor arrays to measure those carefully. We are going to bring in a group of Mayo employees who have all volunteered. Everything we do will be IRB approved research. It will be the same type of quality research that Mayo does everywhere else so there are no shortcuts. But they're going to relocate their actual workstations from another building; they are going to come and work with us for at least the 9 or 10 weeks and during which time we will make subtle manipulations to the light, the sound, the temperature. We will look at their responses. We will look at the environment's response. We will look at our ability to control and measure all of those things and then come out of that with a pretty good idea of how to handle some of those, what I would call, hard endpoints.

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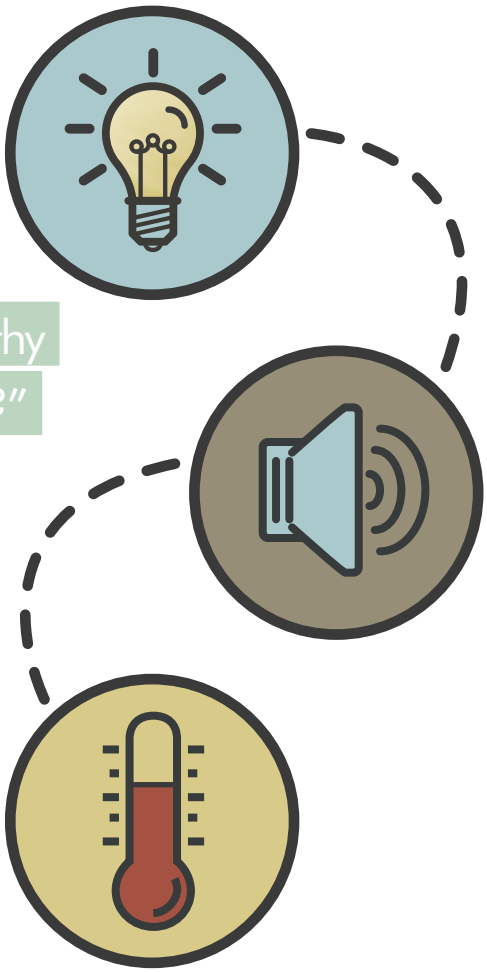

"So how do we keep somebody comfortable and healthy in an environment that is serving many different needs?"

Subsequent studies will have a little more focus on the air quality looking at particulate matter, VOC, CO2, answering the question, for example, *does CO2 impact productivity, and if so how do we mitigate that?* So beyond those things, the standards then start to go into things like nutrition. Again, how is the indoor environment impacting our nutrition? But I think there are lots of clues and cues we get from our environment about what to eat and how to eat; so we can explore a lot of things in that range. Water is another area of focus in terms of the WELL Building Standard. How do we make sure we are getting clean water or pure water? Then the whole concept of comfort branches into ergonomics but also back into temperature. We all have different tolerances for different heat, humidity. Again, another component is the acoustics. We know there is a lot of interest in open offices, but that often introduces extraneous noise which some people find very bothersome. So how do we keep somebody comfortable and healthy in an environment that is serving many different needs?

RP You mentioned productivity, and some of the outcomes you are looking at are biometric markers as well. Are you going to go in and test how the environment impacts blood pressure for example?

DR. BAUER Yes. I think those are critical points. We are doing a fairly comprehensive intake assessment which will include being able to access their medical records, very extensive surveys looking at everything from stress levels, to eating habits, sleep habits, social habits, are you an introvert or extrovert, pessimism, optimism—a lot of diving into who the person is. We are trying to minimize the invasiveness so we are not incorporating a lot of blood tests, but we are at least offering the opportunity to collect stool microbiome so we can look at microbiome and what effects an optimizing environment might have on that. But we have the capacity to do any test that would be warranted for a trial. But again, part of the value or the sweet spot for this lab is it does not feel like a lab. So the more we can get the data from either some simple surveys, click a couple things on the computer each day tell us how you are feeling and then really rely on the biometric data. So for example, some of the bands we are looking at obviously can collect heart rate but also position and galvanic skin response, another marker of stress. We have some that can look at heart rate variability which is another really good marker of stress.

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There are some additional tracking capabilities we do not have fully implemented yet in the lab, things that can actually tell us where the participant is moving. Are they walking over here, walking there? Facial recognition monitors can actually look at your face and tell us what kind of mood you are in. Are you paying attention or not? So as we start to look at that, all that should be fairly unobtrusive. For example, most of the sound, light and temperature sensors are not visible. They are just embedded in the ceiling, they are embedded in the furniture, so that we get a lot of human data and biometric data along with subjective data from the surveys. Then as the need arises, we can certainly do any type of blood tests or other fancy tests. We are connected by skyway to the rest of the Mayo campus so it is a short walk from here to do something fancier if we needed to.

RP I know you guys have not had the opportunity to conduct a whole lot of research just yet, but are there are there any initial findings that you would be willing to share or any surprises that have come out of the work you have done so far?

DR. BAUER Yeah. We have not yet had our human participants enrolled in the lab yet. It will probably be the end of the month before they will get in there. But even what we have learned about how the lab operates is very interesting. Building science is not my forte, but what was interesting as we looked at where some of our first subjects are coming from, we analyzed their offices and it turns out that their offices are spread out across a large floor in a different building. One half of the building has a very different ventilation system and different window structure than the other half.

So even though it is essentially one floor, it is all one group, it really is two separate microclimates if you will. One has much better airflow, but it has more noise because of the rumbling of the machinery. The other one has less airflow but it may be better noise-wise. So it was kind of surprising to me how much variability there was in just one office area. It will be great to see, when we actually start to answer these questions, how much variability there is and how much interest there is from employees in knowing that there is a way to alter things to make them more comfortable or healthier.

RP What implications do you think this will have on homes, worksites, hotels, schools or really any built environment for that matter? Do you see major things that will be coming out of this in your early analysis?

DR BAUER Oh, I sure hope so. There are a lot of smart people putting a lot of effort and time and resources into this. We should be successful for the simple fact that the lab is highly configurable. So what that means is right now we are starting out with an office setting. We have some cubicles; we have some open space, but because it is configurable that literally means we can take up walls and take down a wall. Across our six modules, we could actually have 60 office spaces. We could have 12 hotel rooms we can convert into eight apartments. The floor is raised, and the ceiling is raised so that if tomorrow somebody came and said we have a different light configuration, it is all pretty much plug and play. We can pop out the current lights and put in a new light system. Or if you come up with a really cool new technology that required some cabling, we do not have to knock out walls or go through big building permits. We have the floor is set such that you can just take a couple screws, lift up some panels and we have got a lot of space to pipe through all kinds of new the things.

When you start to think about it, what we do not know now is what technology is going to be available in six months or a year, but we built this space in a way to make it highly configurable and also somewhat agnostic. By that I mean, the system is geared to handle it all. So as we look at hotel rooms, as we look at homes, as we look at apartments, as we look at workspaces, with that kind of technology and that kind of nimbleness, we really should be able to answer the important questions and have a meaningful impact on what goes on in those environments in the future.

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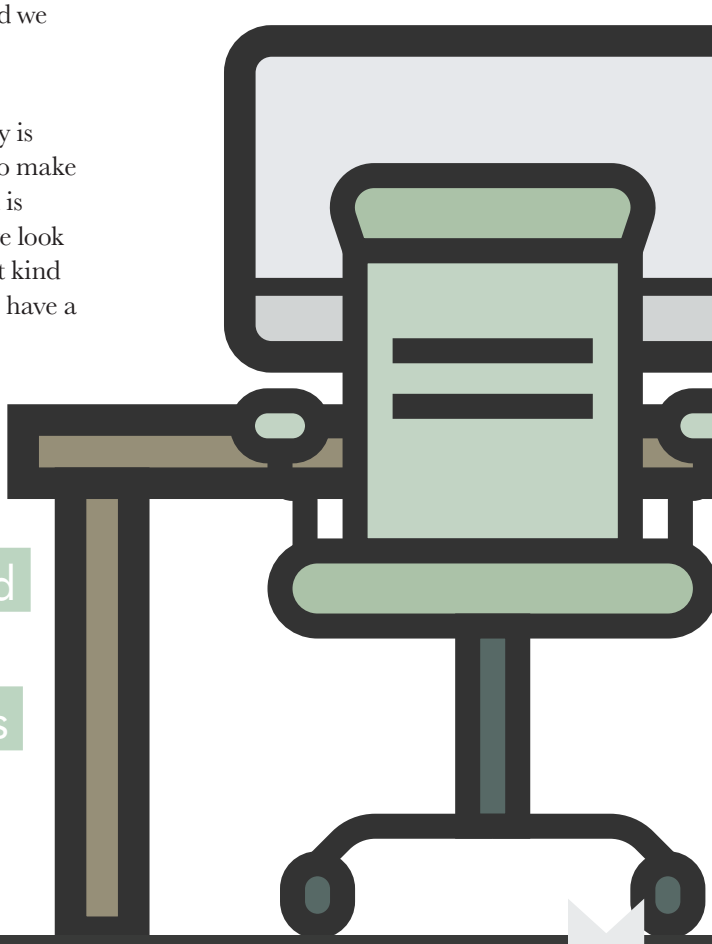

RP That is interesting. Is there any one aspect of the indoor environment that organizations are not looking at as a determinant of health that you think actually has a very large impact?

DR. BAUER Yeah, so it is kind of like when patients ask me what the recipe is for staying healthy. It is nutrition. It is exercise. It is stress management. It is having strong support, community, honoring your spirituality. Then when somebody asks me well, which one of those is the most important? You really cannot say one or the other. Let's pick on carbon dioxide as an example. We know when we put a lot of people in a conference room, about half an hour later people start getting drowsy. The temperature goes up, carbon dioxide goes up. So wouldn't it be nice if we learn what level is tolerable and what level starts to affect productivity? What if we actually had the systems so now the building could actually sense that without us as employers or employees having to take an action? The system could automatically kick up the HVAC and mitigate that rise in carbon dioxide.

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"I think we can make buildings smarter to help us get healthier."

So I think that is one thing. I think we can make buildings smarter to help us get healthier. But then I think the other thing that will come from this is the ability to get feedback from our desks, from our computer, from our other workspace things, our bed. We have got all this great technology now for home use on how we sleep and things that can monitor the light and sound levels in our room. So I think it is not going to be one thing; I think it is going to be when we realize as humans that we really have to do it all. We really have to optimize that healthy environment around us both at work and home, probably in our car, where we spend that time indoors along with the good nutrition, exercise, the stress management, the community, the spirituality.

RP I could not agree with you more. One industry that comes to mind that has been doing this for a long time are casinos. They want to keep people captive and focused, so there are not a lot of windows for example. Has there been much research around these types of strategies for different kinds of outcomes than what a casino might care about?

DR. BAUER I think probably from the reverse angle. I think there is an inverse incentive there. You hit the nail on the head. You do not see windows in most casinos. There are a lot of cues that are given so that you are not really aware of the passage of time, and by doing that they get to keep you at the tables which is where the money comes from. No question, we can use the environment to influence our behavior. We can use the environment to influence our health. Sometimes that can be positive; sometimes that can be negative. But I think again it just tells you the power is there.

RP What is the specific role that you see Mayo playing in solving these types of problems? Is it a pure research role or do you see specific resources coming from your work in the lab?

DR. BAUER I think it really has to be *practical research*. There may be somethings we do for the sake of science, but really the science has been done in other labs. So there are labs that focus on light; there are labs that focus on sound and so forth. Most of those though are labs. They feel like labs. Their participants are strapped in, sensors all over the place; you might wear electrodes on your scalp. So you learn tremendous data there, but you cannot really say how that translates in the real world. I think what we have done is taken that learning from a lot of our smart colleagues around the country and around the world, condensed into not just focusing on light or sound but taking a look at everything. And by the way, we are going to do it in an environment that really feels like your apartment or really feels like your workstation, and we are going to get that data without all those encumbrances. I think we are kind of taking it to the next level if you will.

RP I love it. I have to say that I think you have one of the coolest jobs. You must feel like a kid in a candy store sometimes. I mean, to be able to have that type of environment and to be able to test all those things must be really exciting to wake up every day and do.

DR. BAUER If you ever have a chance to come to Rochester and just walk through it, it is like being a kid in a candy store because, I mean, we have got such smart people. We have got Mayo IT folks who are just phenomenal. Delos has brought industry partners who are just phenomenal. They sit together and I say, you know what I'd really like to be able to do is on the computer screen, slide a bar and so it likes like a thermostat at my home and I want to be able to do that from here. And then next day I walk in and on the computer screen is a little bar that looks like my thermostat at home and I can move it and I change the temperature. So we are really kind of kids in a candy store because we get to ask, "What can you think of that would allow us to answer questions nobody has ever answered before?" Then like the next day smart people come in and tell me, "Oh, yeah we did that overnight."

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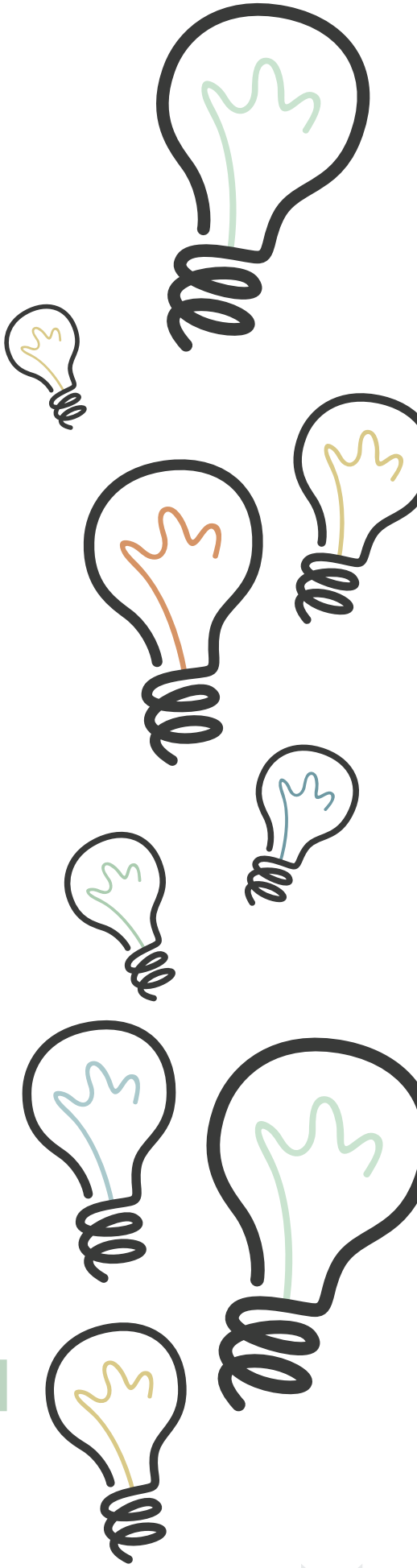

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