The Water Molecule: How Montessori High School, International Baccalaureate, and University Circle Bond to Form a Sustainable Molecule

by Marilyn N. Doerr, Gregg Good, Michael Waski

Using the water molecule as a metaphor, Marilyn Doerr presents a study of a Montessori high school that combines the elements of Montessori with International Baccalaureate (IB) and other institutions in the surrounding community that enrich the experience of the students. The pedagogy of the high school, she explains, must be based on an understanding of human development. As we see throughout this journal, when we think of human development at the high school level we must think of the adolescent developing their sense of social justice and personal dignity. Doerr explains some of the practices of the Montessori High School in Cleveland's University Circle, touches on brain development and the characteristics of adolescents, and finally explains how IB and local institutions enhance the development of the adolescent to achieve a sense of social identity and responsibility.

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She revised and updated David Owen's 1985 book None of the Above, *published in 1999 under the title* None of the Above: The Truth Behind the SATs. *She has written curriculum for one of the Cristo Rey schools and has written green curriculum for Ruffing Montessori School in Cleveland Heights, OH.*

Gregg Good *was named the head of school at Montessori High School at University Circle in 2016. He has served as a consultant and program evaluator for IB and is currently the vice president for superintendents and heads of school for the Ohio Association of IB World Schools. Good holds a master's degree in curriculum and instruction from Arizona State University and a PhD in educational administration and supervision from Arizona State University. He has led numerous workshops for administrators and teachers, nationally and internationally, that have focused on building, sustaining, and evaluating the International Baccalaureate Diploma Programme and other branches of IB. Before coming to Montessori High School, Gregg served as the executive vice president of St. Edward High School in Lakewood, OH where he spearheaded the introduction of the International Baccalaureate Diploma Programme. At St. Edward, he provided leadership for faculty, chairs, and deans and oversaw academic programming while leading the development of innovative curricula in entrepreneurship, film production, and data analytics.*

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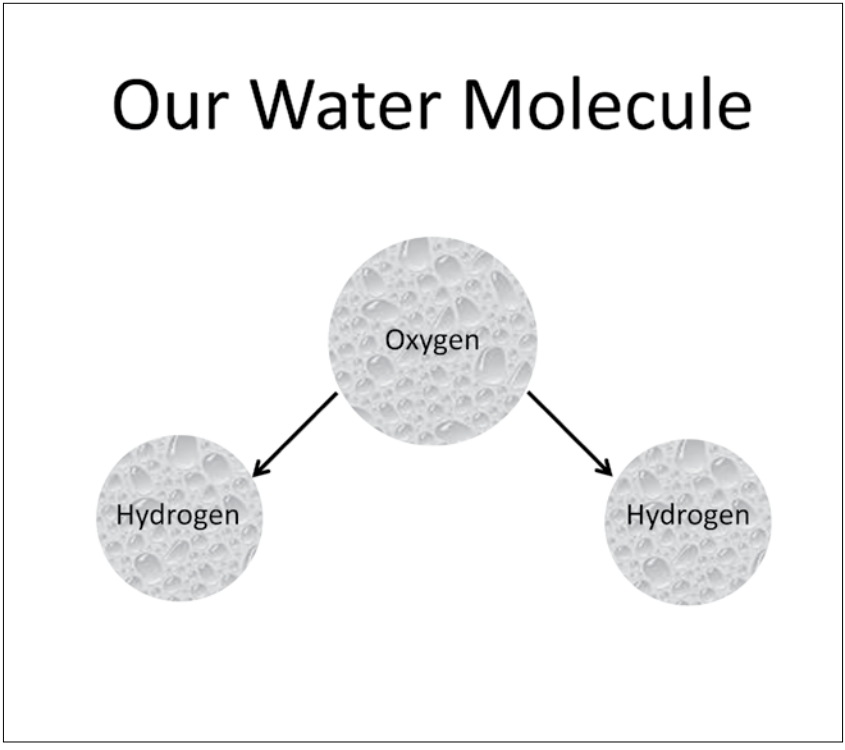
> Here is an essential principle of education: to teach details is to bring confusion; to establish the relationship between things is to bring knowledge. (*From Childhood to Adolescence* 58)
>
> The biosphere gave rise to the human mind, the evolved mind gave rise to culture, and culture will find the way to save the biosphere. (Wilson 50)
>
> Facts fall from the poetic observer as ripe seed. I milk the sky and the earth. The foundation of all is observations. (Thoreau 140)

A Montessori high school is a twenty-first century invention. Maria Montessori did not live long enough to invent it herself, but

the appendices in *From Childhood to Adolescence* recorded her thoughts for adolescence beyond the Erdkinder. The idea of the Montessori high school was created by a group of experienced Montessorians who definitively connected her ideas through a modern lens to help provide a framework for that unique creature: the older adolescent. This essay starts with something very familiar to her.

The Water Molecule: Montessori's Symbol for Nature's Most Universal and Combinatorial Molecule

Water is our most familiar chemical companion. It's the smallest and simplest of the molecules in our bodies. All life exists in a water solution, a legacy of life's origin billions of years ago in the ocean, the primordial soup. Our own bodies are 60% water. But water is also a very unique molecule; it loves being water. Everything is designed, from its polarity to its composition, to make it stable and secure.



The unique characteristics of water are known to us, but we seldom realize how lucky we are that those characteristics exist. Water:

- expands on cooling to 4°C, allowing for blankets of ice over ponds and rivers to protect animals and plants during the winter;

- is the universal solvent – Maria Montessori said, "The great cosmic function of water is to dissolve rock";

- has the ability to "climb" on itself, allowing xylem in plants to carry water throughout the plant – with its unique angle of bonding, approximately 105° – hydrogens are not opposite of oxygen in the molecule – the molecules can "climb" on themselves;

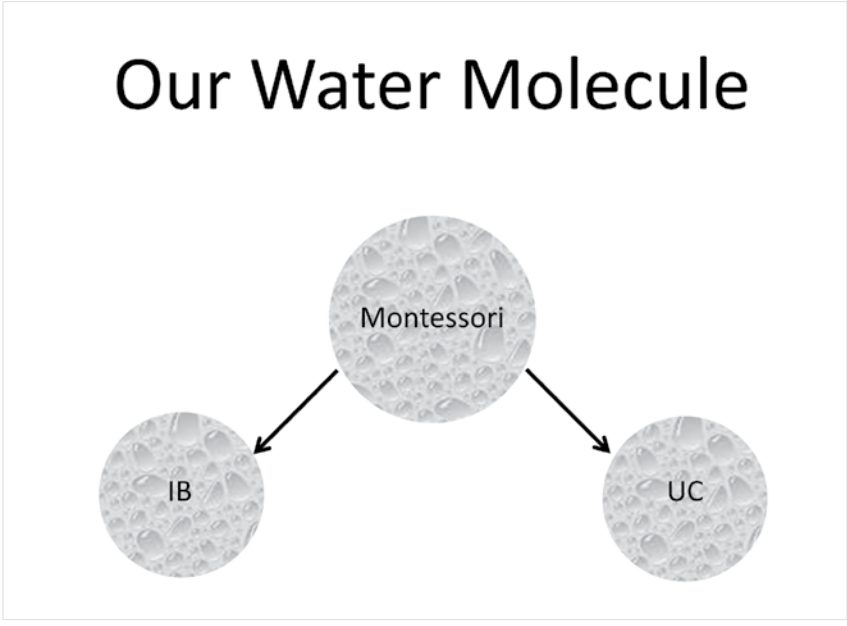
- wants to be water–it is very stable, thus difficult to break up; and

- water retains heat. As water changes from liquid into its gaseous state, vapor, it takes up an unusually large amount of heat. This is why sweating is a useful cooling device for humans: heat from your body is lost as the water in sweat evaporates. Importantly, it also takes a relatively large amount of heat to raise the temperature of water. The temperature of a given amount of water is raised only 1°C by an amount of heat that would increase the same amount of ethyl alcohol by 2°C, or of chloroform by 4°C. This important phenomenon contributes to the surprising constancy of the temperature of the oceans and other large bodies of water through the seasons of the year. This constancy is useful to the organisms living in lakes and oceans for it means they need not adapt to great variations in temperature. In addition, the relative constancy of water temperature helps to minimize variations in atmospheric temperature throughout the planet.

Water is made up of two elements: hydrogen and oxygen. In *From Childhood to Adolescence* (40) Montessori writes, "Hydrogen, the light, invisible gas which seeks to escape, and oxygen, another gas which is always contained in the air – both of which we never see, but which are necessary to us . . . are breathed by all, even the fish in the water. Oxygen is a surprising gas. It is because of it that things burn." Our air is 21% oxygen.

Why do the two elements come together? We call this "coming together" bonding. Hydrogen has one electron circling its nucleus and it is anxious to give it away. Oxygen is in need of electrons; in fact, it needs two electrons. Two hydrogens then each give an electron to oxygen, and oxygen is now satisfied and stable. In fact, the entire molecule, H_2O, is happy and wants to stay that way. But the bonds are "covalent," meaning they are constantly sharing their electrons with each other, coming apart, bonding back together, in a constant motion of orbiting electrons.

What can we learn from the water molecule in the structure and attraction/perturbation of the Montessori High School at University Circle (MHS)? How do we understand its stability and sustainability in a three-part entity we call MHS?



Montessori is our oxygen and the International Baccalaureate (IB) and University Circle (UC) (for our pedagogy of place) are our hydrogens. When these three join and share, the molecule becomes stable. It is happy and wants to stay that way.

Montessori education at its heart is about understanding the natural development of a human being and then preparing an environment to aid the child in that development. Human development is the powerful bonding agent in Montessori education. Each stage of development is unique and brings with it certain gifts and abilities. Montessori recognized, through her training as a physician and through careful observation, that children had sensitive periods when nature propels the child forward to develop certain skills: the ability to talk, to read, to write, to count. And then she developed materials to help the child take advantage of those sensitive periods. The child does not work alone though. There must be an adult to help and encourage this growth: to expose the child to thousands of words, to develop the manipulative skill needed for writing, to understand how words are formed, and how letters can only fit together in certain ways. Montessori called these sensitive periods *planes of development* and the Montessori schools nurture those planes.

MHS' Mission Statement

Montessori High School at University Circle is an independent school based on Montessori principles. It is designed to provide an optimal environment for adolescents to become confident, empathetic, and principled adults who think critically and take informed risks to shape a sustainable and peaceful world.

From its urban residential campus, Montessori High School provides a rigorous, student-centered developmental program of work and studies that inspires each adolescent to find his or her identity and individual path to independence and adulthood. Developmental focus is like the hydrogen-oxygen bonding in liquid water.

It is fairly easy to see the sensitive periods for the young child and the early and late elementary student, but adolescence is more nebulous. Because the adolescent brain at this period of development

is developing much more nonlinearly than linearly, there is not a clear point at which one can delineate a certain skill. So the school and its curriculum for the early and late adolescent need to address key attributes of this nonlinearity. This paper will concentrate on what we have seen as the key characteristics.

Adolescent Needs

Montessori realized early on that all children desire independence and that independence should be fostered. Adolescents particularly have a need for increased self-reliance. According to the American Psychological Association, today's adolescent is defined as someone between the ages of 10 to 24. They need to articulate their ideas to the world at large and to present their talents in the hope that the world will recognize them and need them. They want to feel useful. Over time, adolescents become more tolerant of failures and shortfalls in themselves and in others. They are concerned with justice; they want the world to be fair. Montessori herself wrote that if we could declare sensitive periods for the 12- to 18-year-old adolescent, they would be for social justice and personal dignity. These are represented in the bonding of our educational model. Social justice and personal dignity are part of the "molecular structure" of the adolescent personality, arising out of the adolescent's natural tendency to absorb the characteristics of the social environment of the school.

How MHS Helps Adolescents to Be Valued Citizens of the World

> History is governed by those overarching movements that give shape and meaning to life by relating the human venture to the larger destinies of the universe. Creating such a movement might be called the Great Work of a people. (Berry 1)

Students need to have the ability to have adult conversations; they must know how to organize their thoughts, evaluate facts, present an argument, and listen to and have empathy with others. They need to be able to process data and form educated opinions and to communicate to others in a respectful way. Moving forward from communication with individuals or small groups, they need to know how to live in a community with a diverse range of people. In

order to participate in society in ways according to their talents, gifts, and interest, they should have a love of learning, which of course requires the requisite skills needed to be in their field. This often begins with a college education, and so students should be prepared for college in the academic sense, both in content and skills.

As much as adolescents want independence, they need to realize they are not fully in the adult world; their behavior has less dire consequences than true adults who have jobs and families. But there still must be real authentic work for them to do with consequences. MHS provides an environment where students can still practice living in an academic and social community with one another but also have authentic experiences out in the world at large. The high school proper serves more as a staging area where the students have access to real work in the adult community but still have a safe home to return to, to reflect, to learn, and to grow.

The Montessori approach to the disciplines is through the psychology of the age group. Montessori therefore calls these *psycho-disciplines,* and they are the key to developing any curriculum or program elements in a Montessori school. MHS has two main functions in preparing the adolescent for the adult world: It must prepare them socially as well as academically. All MHS' program and curricular elements aim to help develop the adolescent in both these ways. Once again, the bonds between Montessori education, IB, and UC intersect with the developmental aims embodied in the psycho-disciplines and the psychological sensitivities of social life and mission, independence, and intellectual life in the circle.

After multiple experiences with Socratic discussion, students are able to move these types of intellectual conversations outside of the formal seminar and to places outside of school. Students enjoy group work because they are social by nature, but through activities such as seminar, they learn how to be more tolerant of failures and shortfalls in others and in themselves.

Whenever possible, MHS teachers try to put students in contact with authentic adults (experts) and the school's curricula and programs in general are shaped around this need. The location of the school is

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important as students have easier access to experts and adults and institutions in which they can participate. Teachers acting as facilitators bring experts into the classroom or take them to the experts. Students can have apprenticeships or internships where students are working side by side with adults in the adults' environment. This allows the students to take their identity into the outside world and try on different roles. They put into practice the social and academic skills they have practiced and acquired.

A huge influence for students is their teachers with whom they spend much of their time. The teacher must be prepared for this role and recognize the enormity of the role they play in helping adolescents shape their own identities. Students observe and learn how adults interact with each other, how they solve conflict, how they gain happiness in life, how they deal with adversity, how they

are lovers of knowledge, and how they continue to grow. The more adults they interact with, the richer their growth will be. This is just one example of serving the students' needs for a rich academic environment along with social and personal growth.

Another part of the MHS pedagogy is student presentation of findings and research to an authentic audience. This helps the students' need to present their ideas to the world at large. Sometimes this is done in a symposium-style setting. Here, experts from the field will be present to ask questions and critique the presentations. The students do research not just for themselves, but for the experts, and so this is a modeling of academia. Another way MHS allows students to share their research in authentic ways is by doing large projects that have real effect on the community. For example, students might do a water quality study in a chemistry class that gives them academic skills, but then they may present their research to a city board. Again, students are doing authentic work and meeting their academic goal while their adolescent need of participating in society at large is being met.

The specifics of academic content for classes are flexible and dependent on the needs, interests, and resources of the community

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at any given point in time. However, whatever is chosen should be its natural appeal to the adolescent. Adolescents are trying to find their role in the world and are very interested in anything that allows them to explore and solidify this role. An example of this would be choosing academic content that is connected to social justice. In cases where required content itself might not be directly relevant, then the school tries to find ways for it to connect to some aspect of the student's personality. For example, in mathematics, MHS looks at the historical context in which a discovery is made and the cultural significance of it. Ergo, students can relate to the ideas better and can think of how things today might be affected in a similar way, through perhaps new technological advances. Studying figures from history and telling stories offers another chance for modeling and side-by-side work. Opportunities for self-expression through the arts and writing allow students to self-create and explore who they are. These methods are appealing to the adolescent and can be used interdisciplinarily to maximize student engagement.

Another important aspect of a Montessori education is the Socratic seminar. Students must first learn how to read and interpret text, how to assimilate knowledge, form opinions, and be critical thinkers. After this, they have a discussion where they must present their ideas, listen to each other in turn, discuss ideas critically, and agree or disagree in a civil way. In this structured environment, students learn how to have conversation and how to present ideas in many contexts. After multiple experiences with Socratic discussion, students are able to move these types of intellectual conversations outside of the formal seminar and to places outside of school. Students enjoy group work because they are social by nature, but through activities such as seminar, they learn how to be more tolerant of failures and shortfalls in others and in themselves. The school is giving them the tools to be social in a positive and respectful way, one that truly prepares them for adult life.

Students also need large amounts of uninterrupted work time in their schedule. This open time allows students to get deep into their studies and work without interruption, what Mihaly Czikszentmihalyi would call *flow.* They learn how to organize their time, they make decisions regarding what their work will be, how they will prioritize their work, and so on. Flexible time allows teachers

to offer larger projects and individualize learning because students have time in their day to get extra help, receive additional lessons–both remedial and advanced–and to work in groups or individually. Open work allows for freedom, yet offers a chance for responsibility as students learn to take more ownership of their education.

Advisory periods are another way adolescent needs are met. Each year students are assigned to an advisor (generally a teacher) who meets regularly, at least once each day, with that advisory group to deal with issues that come up that day or week, and to help students build close relationships with the group that are different from relationships in academic classes or internships. Advisory groups generally stay together throughout the four years.

Another feature of MHS programs is the inclusion of an experiential term, or an intensive. This is usually a one or two week immersion in one topic. Students often have much to say in the design and implementation of these courses. Student design of the course gives students more control over their learning and helps them to be more responsible and thoughtful about the process of learning. Managing their group, scheduling speakers, raising money for trips, and learning how to compromise with one another and work within a real budget all help the students gain important life experience while simultaneously increasing their knowledge base.

Maria Montessori put much emphasis on economics education. Starting with children in the lower elementary, she felt students should make money doing or producing something and then decide how best to spend the money they made. MHS has wanted to have a school business since its inception, and only recently was able to finance and organize a small school café. It will be interesting to watch this business unfold over the next few years and to see how many students are drawn to its operation and its development.

Adolescent Brain Development

Current advances in the study of adolescent brains show us that defiance is a typical part of adolescence; adolescents are wired to proclaim their independence, and as a society our understanding of teenagers has not caught up to the science. In the past fifteen

years, neuroscientists have discovered that a teenager's brain is different in important ways from an adult's brain. It is more receptive to incentives (rewards and punishments) and to socioemotional context, and the parts that control impulses and judgment are still under construction.

A cornerstone of cognitive development is the ability to suppress inappropriate thoughts and actions in favor of goal-directed ones, especially in the presence of compelling incentives. A number of classic developmental studies have shown this ability develops throughout childhood and adolescence.

The immature cognition of adolescence is characterized as impulsive and risk-taking. In context to the linear increase with age associated with impulse control, risk-taking appears greater during adolescence relative to childhood and adulthood and is associated with subcortical systems known to be involved in evaluation of incentives and affective information.

Use of Facebook and other social media sites and the seeming constancy of the need to connect with someone and the use of the word "likes" as though it is a personal emotional attachment to someone or something can have both positive and negative impact on adolescents' needs for socializing. The average American adolescent is thought to be texting 150 times a day. Also, the issue with civil dialogue and its absence in large part from social media communication is alarming. How do we restore civil dialogue that is at the core of democracy? MHS is in a crucial place in that transition to "life as citizen" and the need and responsibility for civil dialogue in a democracy.

In emotionally salient situations, the more mature limbic system will win over the prefrontal control system–the adolescent may know better, but the salience of the emotional context biases his or her behavior in the opposite direction of the optimal action. Adolescents have a bias toward immediate rather than long-term goals. Again, it is important for MHS staff to help the adolescent understand that there are times when they may not realize the importance of quick judgment, but critical thinking about anything we do, say, or write is part of growing up.

The Evolution of Adolescence

Why have humans evolved this way? Why does human development have an adolescence? Adolescence is the period in which independence skills are acquired in order to increase the success of separating from the protective influence of the family. Puberty brings on neuroendocrinological changes with increases in adrenal and gonadal hormones.

The novelty-seeking behavior of adolescence needs some mechanism for detecting cues of safety or danger. The increase in emotional reactivity during this period may allow adolescents to be more vigilant and aware of threat and may aid to ensure their survival as they move from a safe environment to a novel one. In today's society where adolescence may extend indefinitely–with individuals well into their twenties living with their parents, remaining financially dependent, and choosing mates later in life–these behaviors may be deemed inappropriate.

Adolescents make more rational decisions about hypothetical scenarios versus real-life situations. The environmental context and emotional significance of the decision greatly influence the adolescent.

There is also significant difference between the early adolescent (ages 14 to 16) and the late adolescent (ages 17 to 19). As students get older, they of course have an increased ability for abstraction. They are also able to relate and see the connections between several different concepts more fluently. In math, for example, the relationship between the solutions to a quadratic equation, the *X*-intercepts of the equation, the graph of a parabola, and the quadratic formula are now more readily seen as different views of the same phenomenon, and these connections are deeper than before.

There is a difference also in group work. For the younger adolescent, there is more of a group discovery approach, where students will discover a formula or an idea as a collective together. Some students may seem as if they are just pulled along for the ride, but this is part of the early adolescent brain's development with socialization: They really need the group dynamic to process information for themselves. But as the students get older, they tend to do more work by themselves and to share and discuss ideas that they have

had time to process on their own; they have learned that knee-jerk reactions are often not helpful to the individual or to the group. So the math or whatever discipline becomes more personal in a way. Students also tend to move away from the question "When am I going to use this?" to "What is this used for?" There is a big difference between those two questions.

Over the four-year span of adolescence that is witnessed in high school, adolescents in general concentrate better, have a more calming presence, can and want to work alone more, and have a more meta-cognitive view of their own learning.[1] Focus and attention generally increase as well as academic seriousness.

How International Baccalaureate Enhances the Developmental Bond of Montessori: Making a "Happy" Molecule

> Freedom is self-restriction: restriction of the self for the sake of others. (Solzhenitsyn 551)

IB's Mission Statement

> . . . aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect. To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment. These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right. (International Baccalaureate)

Montessorians are quick to point out that the ultimate objective of Montessori philosophy is to guide adolescents to becoming adults who will focus their energies on crafting a world of peace and unity. This foundational focus on a more peaceful world is embodied in the IB program.

Montessorians routinely stress the role of the teacher as a guide for the adolescent becoming an adult. There is further emphasis on

1. Cultivated at MHS through work in the meta class, Theory of Knowledge, in the IB DP, to be discussed in more detail later in this article.

the need for student choice and creativity to focus on what is most important to the student as an individual. A relatively new emphasis on pedagogy within the DP (the Diploma Programme, the program developed for the last two years of high school) aligns perfectly with this educational philosophy. The DP has seen the importance of pedagogy in making the DP applicable for all students. As the IB OCC (Online Curriculum Centre) web page on "Approaches to Teaching and Learning" describes it,

> DP teachers play a crucial role as teachers of learners, not simply teachers of content. One of the most important considerations for these teachers is how to design teaching practice to produce effective inquiry learning within the quantity of important information in each discipline that needs to be addressed. What matters is not whether DP teachers adhere to any particular model, but that they focus on making sure their students are engaging in inquiry, on finding their own information and constructing their own understandings as often as possible in their classrooms. In this approach, the teacher is seen as a facilitator [a word often used in Montessori practice].

Montessori High School does an outstanding job empowering students to realize Maria Montessori's vision of interaction with the real world. One way MHS brings community interaction to our program is through two X-terms, which is two-week intense experience on a single topic. From the MHS website:

> At MHS, the mid-year and end-of-year experiential term, or X-term, gives students an opportunity to independently plan and manage a two-week learning intensive. Students learn to set a vision, manage logistics, lead within a group of peers, and creatively meet their group's needs. Fundraising often takes center stage in the planning process as students find ways to fund their plans, which can include travel or equipment purchases. Students have raised funds to support X-terms that included travel to San Francisco, New York, and an Appalachian Trail trailhead. They have also purchased equipment to build a 3-D printer and a jet engine.

The IB internal assessments, or IAs, also allow the adolescent to choose topics within the context of particular disciplines; e.g., historical investigations are on topics of particular interest to each

student, lab research in science courses is individualized and not "cookie cutter," and performances in the music course are created and implemented based on a student's interests and preferences. Every one of the IAs is project- and problem-based, and students should be comfortable with ambiguity and nuance and seeing failure as part of learning.

At the center of the IB DP is Creativity, Activity, and Service (CAS). At MHS, CAS has become the model for how our students engage in service to and create relations with the UC institution partners. Whether interfacing with the Cleveland Museum of Art, the Cleveland Botanical Garden, the Cleveland History Center, the Music School Settlement, or Case Western Reserve University, MHS students utilize CAS-directed outcomes and reflections to ensure deep and meaningful engagement. Some past projects have included maintenance and landscaping work at the high school and at the botanical gardens, assistance in data collection and tabulation with researchers at the natural history museum, development of videos for the observatory at the natural history museum, summer humanitarian work in Costa Rica and Haiti, tutoring young students at the two local elementary Montessori schools (Stonebrook and Cleveland Montessori) and visitations to residents at Judson Park, an assisted living facility within UC. The hope at MHS is that a student's involvement with CAS becomes a four-year project in which the student can become more deeply involved with the institution and see growth for himself or herself throughout that time frame. This four-year time frame allows the student to set specific goals and to see growth, plan and initiate activities, work collaboratively, persevere, and eventually be able to decide the ethical implications of the project: contributing to making a better world.

Montessori's theory of connectivity stresses the importance of integrating disciplines to bring meaning to learning. Without that interconnectedness, adolescents cannot apply the global context that gives each individual discipline significance. Ideal learning then takes the form of a *Cosmic Education*. True integration has elements of freedom and of practical work. It is not theme-based. Theme-based curricula are simply linguistic ties; they are not the natural process of overarching areas. There is actually a spiritual

dimension to integration. E. O. Wilson, in his latest book, *Half-Earth: Our Planet's Fight for Life*, crusades for integration:

> It is often said that the human brain is the most complex system known to us in the universe. That is incorrect. The most complex is the individual natural ecosystem, and the collectivity of ecosystems comprising Earth's species-level biodiversity. Each species of plant, animal, fungus, and microorganism is guided by sophisticated decision devices. Each is intricately programmed in its own way to pass with precision through its respective life cycle. It is instructed on when to grow, when to mate, when to disperse, and when to shy away from enemies. (206)

To understand the individual natural ecosystem, we need to study the whole of it.

The IB DP emphasizes integrated learning. IB schools are required to build cross-curricular units throughout their courses. IB provides the schools with "unit planners" to facilitate that process. MHS, too, has made integration more concrete by insisting that courses promote integration. For the past several years, MHS teachers have led history symposia requiring students to work collaboratively across disciplines on creative projects. The fall of 2016, students in grades 9/10 generated utopian societies that included constitutions, political and economic systems, environmental regulations and healthcare delivery models. This type of problem-based project is celebrated within the DP.

This is hard work. IB is aware of that and encourages integration by recognizing the need for teachers/facilitators to push for that transfer of knowledge. From the IB website:

> The DP encourages transfer through its emphasis on concurrency of learning. By studying different subjects concurrently, it is intended that students will have more opportunities to make links and connections than they would otherwise. However, solely studying different subjects at the same time is not enough to guarantee that students are effectively transferring their learning. Instead, there needs to be explicit teaching for transfer; for example, explicitly encouraging transfer by exploring concepts across multiple subject areas, or by encouraging

students to make connections between their learning in the different subjects.

Adolescents, especially late adolescents on the verge of adulthood, are more aware of local, national, and international social justice from a community perspective. They want to better understand human society and to develop a sense of civic responsibility as they recognize that the community's problems are their problems. MHS is called to do more for humanity: We help each child develop a vision for becoming a global citizen and for social activity. IB's emphasis on international mindedness enhances our ability to expand that knowledge and development as much as possible.

Another program unique to the IB DP is the Extended Essay, or EE, a research essay of 4,000 words, with the topic chosen by the individual student.[2] There is freedom in the EE. Students can write about anything that has a research component and on a topic that will help encapsulate the research process. Just this past year, students researched and wrote on the impact of Ansel Adams' photography on the National Park System in the years 1920-1940, the relationship between elapsed time and total energy of an oscillating system, analysis of Richard Strauss' orchestration in his Tone Poems, and efficient and alternative ways community members can help people who live in food deserts in northeast Ohio obtain fresh food. Students may have researched those topics without the IB EE class, but the EE class formalizes the process, helps the students assess

2. In 2012, the University of Virginia conducted a study on the efficacy of IB for its students, especially in the area of the Extended Essay. A sizeable percentage of the students who apply to UVA also have participated in the IB program, especially the IB DP. Approximately 1,000 undergraduate students participated in this study, both with responding to a quantitative survey and participating in two qualitative studies – one as group conversation, the other as individual interviews. The results concluded that the "Extended Essay is, indeed, having an effect on students' research confidence and willingness to engage in future research" (41). The IB students experience skill development in 1) writing skills; 2) gathering and evaluating sources for research; 3) time management; 4) anxiety reduction around college writing assignments; and 5) bolstered creativity and autonomy with pursuing a personally chosen research topic. 73% of those approximately 1,000 students continued to do long-term research at UVA as undergraduates. In general, these students did not feel overwhelmed by college-level research, and were found to be self-motivated. The EE process, too, inspired a sense of camaraderie among those fellow IB alumni at UVA which promoted their sense of self-sufficiency (Inkelas, et al.).

their own and others work, and provides a culmination event that honors each student's creativity and hard work.

A third program unique to the IB DP is the Theory of Knowledge class, or TOK. At MHS this class meets once a week for the two years of the IB, grades 11 and 12. This is a meta class: How do we learn? What constitutes knowledge? How do we know that what we are learning is true? What is truth? Adolescents love this class; they want to dissect their own learning and figure out with their peers their own proclivities and why they might be that way. TOK is part of the human condition; it allows for a visualization of humanity as a whole.

IB also re-examines in depth each of their course offerings every seven years. A special global panel with experts in each field meet together to revisit what they have gleaned from the past seven years and review the reports and data received from faculty and staff on what is working, what is not. Often, significant changes are made. The new emphasis on pedagogy came from just that re-examination. Small pedagogical systems, such as MHS, cannot afford to bring in a community of experts to examine all or part of a school in detail. This aspect of belonging to the IB system cannot be diminished—not to mention the wide-ranging, literally world-wide, responses available to any changes or considerations of change.

Because of the global nature of the IB program and its emphasis on international mindedness, IB is very careful about the translations it offers for major works and current world development essays and journal articles. That care is transferred to the IB student – how can you be sure this translation is correct? Where did this translation come from? All translations should be handled critically.

Annually, IB holds a world student conference. Students meet at a designated site for a week to explore and experience what it means to be globally engaged and to inspire responsible action for making a better and more peaceful world. This year, 2017, there are two conferences, one in Rochester, New York and the other in London, England. Students apply to attend. The focus is on developing leadership skills and meeting other like-minded students while also having the opportunity to interact with university faculty and

world-renowned speakers representing a wide variety of disciplines and areas of expertise. These skills and experiences are designed to inspire students in the creation of action plans that could be used for community service projects in their local communities.

IB also offers three travel programs every summer, each based on one of three main geographic divisions: China, South America, and Europe. These trips are planned with IB curriculum in mind, and students are given multiple opportunities to seek out and research specific areas from the curriculum while guided by certified IB faculty.

MHS students can participate in those trips anytime during their four years at the school.

Assessment

> Study, like prayer, is a way of being—it is an ethic. (Block, *Talmud, Curriculum* 2)
>
> Teaching and learning might disseminate knowledge, but study enables understanding. (Block, *Pedagogy, Religion* 192)

Elliot Eisner devotes a significant amount of text in his book *The Educational Imagination: On the Design and Evaluation of School Programs* to assessment. He writes:

> When students are not taught or do not learn to see ideas as a part of a fabric – a changing fabric – ideas become, as Alfred Whitehead commented, inert. The challenge to assessment is to *somehow* [sic] create tasks that give students opportunities to display their understanding of the vital and connected features of the ideas, concepts, and images they have explored. In short, the aim is to help students demonstrate that they have grasped ideas as part of a larger field and as historically situated elements within a community of discourse. (251-252)

Because Montessori is a global, universal pedagogy found in almost all major areas of the world, it is important that there be an external assessment for the adolescent program at the end of the four year program. Also, Montessori is preparing students for the

university; Maria Montessori made that very clear in her seminal work with the older student, *From Childhood to Adolescence*. All the more reason for having Montessori high schools use assessments that are recognized by the university community. This is another reason why IB was chosen by MHS to add to its experiment with the idea of a Montessori high school. It is unique, though, to the last two years of the high school program, and because it is unique, it has become somewhat of a bailiwick for those who are not used to assessment.

There are many good reasons to assess. Assessment is a process, and material learned during a period of time–e.g., a semester, a year, a DP sequence–becomes re-remembered, re-energized, and seen as an integrated unit of experiences that eventually makes sense when viewed as a whole. It is an important process for the student not only academically but neurologically. New synapses are formed among gaps of stored knowledge where connections that previously were missed can now form and synergize the pre-existing memes and schema. If we don't do this, we are denying the student the opportunity to make these new circuits, when the brain is still flexible and movement from the hippocampus to several areas within the cortex is much easier. Assessment also gives the teacher a check on whether that one bit of knowledge he/she was trying to instill with each unit did indeed become part of long-term memory. What we work with in high school is what we have, not what we think we should have, or what we want because we want it. It is only through long-term assessment that we are able to "freeze" students at certain points in their development. We never say that a student is incapable. There are countless stories of students who go off to college or other further education, and when we meet them again as adults ten or so years later, we cannot believe how they have grown and developed. This is one of the best things about teaching. We work as if we are helping each person to an optimum; we just don't know where that optimum will lie. We give them many experiences because we know when they leave us, their experience base will be narrowed and limited by choices they will make. How can we not expose them to wonderful literature, to all the arts, to the wonders of scientific method, and to empathy–empathy for other cultures, for other teens, for each other within the microcosm of the school?

Educator William Pinar writes often about the role of study in education.

> Study. Not test preparation. Study is any ongoing engagement with alterity, with what and whom I don't know and perhaps can't understand, at least not initially and perhaps never fully. Study is the medium not only of knowledge but of subject formation, as one comes to form as a person through what one experiences when studying texts of various kinds, including everyday life. (xii)

At MHS we stress the positive aspects of study. In the many years of IB assessment, there has never been any indication that IB testing favors one gender over another, unlike data from the SAT and ACT tests. It is safe to say that the multiple creative, holistic approaches offered in the IB assessment pieces do not favor rote learning nor are the short essay portions troubling for some students because during the two-year IB program, students become very used to writing short and long essays (learning to answer the specific question that was asked of them, writing tersely, and working off of a self-produced outline). When the IB is used as a tool to enhance and assess the student's four-year experience at MHS, it becomes that bond that helps to complete the academic and social needs for the adolescents.

How University Circle Enhances MHS

University Circle is what makes our small school big. MHS is surrounded by museums, hospitals, and libraries. A school of 100 students can never be a cafeteria school. We believe in adolescents having common experiences, but that doesn't mean that we can't offer unique experiences to our students when they show the interest and initiative to explore something that for the present is not in our general curriculum. That is where UC enhances our program.

MHS does not have field trips because our work within UC makes field trips inherent in our students' everyday work. A student needs to research wing development in a study on evolution, so she calls over to the natural history museum and arranges for a time to check their bird specimens in the basement (an awesome place to visit for any reason). A student wants to hear the concerto mentioned by Murakami in *The Wind-Up Bird Chronicle*, so he walks over to the

Cleveland Botanical Garden © Diane Hansson, UCI

institute of music and spends some time with their unique library. Dance students walk over to the music school settlement at least twice a week to use their barres and mirrors. A student researching her topic for her IB history paper can spend hours each afternoon at the Smith-Klein Library, the main library at Case Western Reserve University, another short walk from the MHS campus. If a student needs a quiet space to concentrate on a project, he can use the outdoor benches at the botanical gardens or the indoor benches at the art museum to find a beautiful space in which to think. Think Box, a new 7-story building on the Case Western Reserve campus, is designed for open-access innovation. It is a maker space fostering entrepreneurship, production, and integration to study innovation and creativity leading to economic and social advancement. MHS students have access to Think Box. Students and faculty also use UC to help students with their community service projects (the CAS arm of the IB curriculum circle).

Montessori calls her "essential reform" of secondary education a "school of experience in the elements of social life" (64). Work and

study in the prepared environment would be based on economic and social understandings placed within a place context. Place builds a context for social relations; it is the staging area for human community structure enhanced by a deep encounter with the natural and urban worlds.

> To know one's place is to have an intimate knowledge of the local environments (both natural and built) and the various professional roles, shared histories, and interdependent relationships that sustain the community over the long term. To further strengthen ties to the local community, students' participation in community projects that help to nurture culturally significant relationships between young and old can be fostered by way of apprenticeship-style programs and community renewal efforts that are within ecologically sustainable contexts. (Hutchinson 153)

Pedagogy of place is the awareness of the place in which we move and live. At MHS, UC is our place. The school's pedagogy needs to reflect that, and UC gives MHS its grounding on which to build its curriculum. It is a vibrant community. Walk the streets of UC on a sunny day, people are everywhere, walking, talking, hustling to classes, slowing to watch the birds. In the winter, the Wade Oval ice rink is full of energy and music. The summer concerts provide music of all kinds. The outdoor food market at the Veterans Hospital and the food trucks bring people from around the circle. It is wonderful for MHS students to feel a part of that community. It is also a diverse community: international students attending Case Western Reserve University mix with medical personnel from the Cleveland Clinic and Mount Sinai and tourists attending art, natural history, and botanical museums. There are approximately 30,000 jobs in the UC area, an area that comprises 550 acres and has a population of 10,000. Of that 10,000, 55% are white, 30% are black, 3% Asian, and 2% Hispanic. This international mindedness enhances IB and enhances Montessori's question, "To what environment must we adapt?" It is we who adapt; the environment does not adapt to us.

University Circle, too, becomes an area of study for MHS.

> Indifference to place is a matter of attention. The campus and its region are seldom brought into focus as a matter of practical study. To do so raises the questions of the most

> basic sort. How does it function as an ecosystem? From where does its food, energy, water, and materials come and at what human and ecological costs? Where does its waste and garbage go and at what costs? What relation does the campus have to the surrounding region? What is the ecological history of the place? What ecological potentials does it have? What are the dominant soil types? Flora and fauna? What of its geology and hydrology? (Orr 88)

Conclusion: We Are Happy That Way

> The precondition for order in a liberal society is an act of the imagination: *not* a moral consensus or shared values, but the capacity to understand moral worlds different from our own. We may be different, but we can imagine what it would be like to *be each other*. (Ignatieff 138)

> Pedagogy is the transformation of consciousness that takes place in the intersection of three agencies—the teacher, the learner, and the knowledge they produce together. (Lusted 2)

> To present detached notions is to bring confusion. We need to determine the bonds that exist between them. (*From Childhood to Adolescence* 58)

What makes the MHS-IB-UC "molecule" a happy molecule? What are the unique properties of this three-fold organizational bond that emerges as part of the personality? Like water, the community bond is strong but the molecule is interactive and combines with elements of the real world, which allows the adolescent personality to mature with developed social understanding and at the same time with a strong individual insight that is combinatorial by nature. MHS-IB-UC:

- **Honors the Adolescent**—Valorization of the personality gives meaning to all of the intellectual and psychological forces of the Montessori adolescent. It includes the personality of the student, his/her work, and independence in a social setting. The personality is the total of a person's individualities and potentialities. Intelligence develops through activity. Being able to do something well, to be competent, is important, involving study, repetition, and concentration. One feels competent within a responsive community. Personality needs to

be allowed spontaneous activities in a prepared environment that is conducive to independence. The healthy and positive development of the adolescent personality is character. Montessori writes, ". . . we ought to remember that there is one thing that education can take as a sure guide, and that is the *personality of the children* who are to be educated" (60-61). Education for life requires self-respect and personality development from tasks of increasing importance to reality and increasing challenge to the individual.

- **Emphasizes Values**—Often through storytelling we determine what values we share. The myth of Sisyphus – endlessly rolling the stone uphill. Camus's take: "It is noble indeed to urge forward in a conscious act of will." When we tell one another a story we transmit meaning.

- **Understands and Values Pedagogy**—We are project-based as we foster competence through study, repetition, and concentration. We foster independence. Our approaches to teaching are inquiry-based, pushing for conceptual understanding. We emphasize a global context, collaboration, differentiation, and formative and summative assessments.

- **Presents a Balanced Conflict**—It is necessary that the human personality should be prepared for the unforeseen, not only for the conditions that can be anticipated by prudence and foresight. Nor should it be strictly conditioned by one rigid specialization, but should develop at the same time the power of adapting itself quickly and easily. In this fierce battle of civil life, a person must have a strong character and quick wits as well as courage; he/she must be strengthened in principles by moral training and must also have practical ability in order to face the difficulties of life. Adaptability is the most essential quality, for the progress of the world is continually opening new careers and at the same time closing or revolutionizing the traditional types of employment. Adaptability is an essential quality for living in a democracy. A well-functioning system/institution/government has vigor, organization, and resilience.

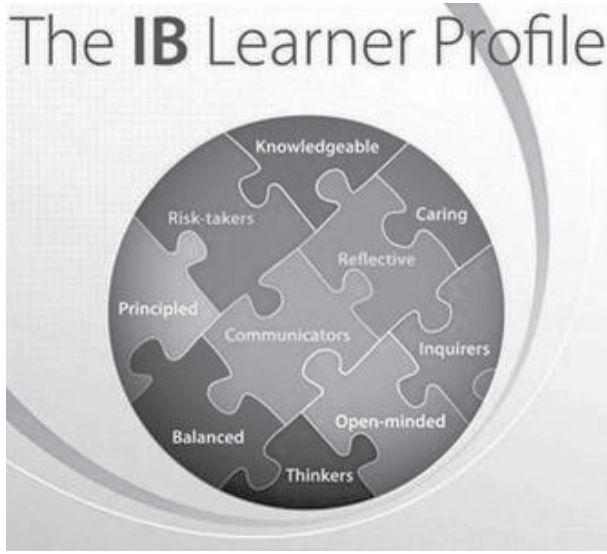
The tight bonds among the three entities make for stability and sustainability. MHS-IB-UC is happy—transcendent—and will stay that way.

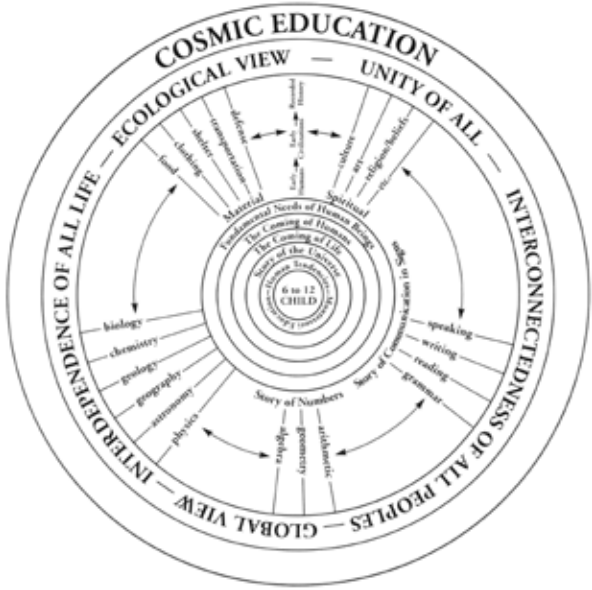
> For whatever reason, the heart cannot separate the world's appearance and actions from morality and valor, and the power of every idea is intensified, if not actually created, by its expression in substance. Over and over in the butterfly we see the idea of transcendence. In the forest we see not the inert but the aspiring. In water that departs forever and forever returns, we experience eternity. (Oliver 114)

Appendix

The IB circle represents the integrated overview of the Diploma Programme, where the learner profile and pedagogy form the core of an internationally minded curriculum. The six areas represented—Literature, a second Language, the study of individuals and societies, the Sciences, Mathematics, and the Arts—form the broad disciplines.

The IB learner profile highlights ten characteristics fostered in the IB DP program. This graphic demonstrates the interconnectedness of those qualities into one adolescent who is beginning to find his/her way into the adult world.





The Cosmic Education circle represents the integrated overview of the 6- to 12-year-old child in Montessori education. Starting with the story of the universe at the center of the circle, the student moves slowly, gently, toward a detailed study of the needs of humans during this seven-year process. At the end of this cycle, the early adolescent is ready to examine her own role in the cosmos.

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