#Ùõ)ÈÔÌÚ&ÐÙÈÙË2ÜÔÔÌÙ4ÕËÌÙÎÙÈËÜÈÛÌ1ÌÚÌÈÙÊÏ/ÙÖÎÙÈÔ

%ÈÊÜÓÛà , ÌÕÛÖÙ ̦

ɯ . ×ÛĐÔĐáÈÛĐÖÕɯÖÍɯÛ Ï Ì ɯÞÈÛ Ì ÙɯÖßĐËÈÛĐÖÕɯÈÉĐóĐÛàɯÖÍɯÉĐÖ Î Ì ÕĐÊɯÔÈÕ Î ÈÕ Ì Ú Ì ɯÖßĐË Ì Úɯφ ! , . ÚȺ

Mn-oxidizing microorganisms oxidize environmental Mn(II) producing Mn(IV)-oxides. *Pseudomonas putida* MnB1 is a widely studied organism for the oxidation of manganese (II) to manganese (IV) by a multicopper oxidase. The biogenic manganese oxides (BMOs) produced by MnB1 and similar organisms have unique properties compared to non-biological manganese oxides. Along with an amorphous, poorly crystalline structure, previous studies have indicated that BMOs have high surface areas and high reactivities. It also known that abiotic Mn-oxides promote oxidation of organics and have been studied for their water oxidation catalytic function. For this proposed work, MnB1 is grown and maintained, and subsequently transferred to culturing media containing manganese (II) salts to observe the oxidation of manganese (II) to manganese (IV). We have shown that we can achieve water oxidation via whole-cell catalysis by a recently published peer-revived article in *Life* journal. Our experiments have led us to explore evolutionary implications of the origin of water oxidizing organisms.

3 Ï Ì ɯÍÖÊÜÚɯÖÍɯÛ Ï Ì ɯÙ Ì Ú Ì ÈÙÊ Ï ɯ×ÙÖÑ Ì ÊÛÚɯĐÕɯÛ Ï Ì ɯ/ (ȥÚɯóÈÉÖÙÈÛÖÙàɯĐÕÝÖóÝ Ì ÚɯÜÕË Ì ÙÚÛÈÕËĐÕ Î ɯ×ÙÖÛ Ì ĐÕɯ structure and function that have applications in the biomedical and biotechnology industries as well as sustainability. The PI has mentored undergraduate and graduate research students for four years at Lewis University and has built a research community of scholars that facilitates a peer and near-peer style of research mentorship. In her short time at Lewis University, the PI has mentored 20 undergraduate students as and currently has three graduate students. Four publications featuring Lewis undergraduates, including a recent publication from a SURE alumna, Elisa Morales, and graduate chemistry students have been published since her research ×ÙÖ Î ÙÈÔȥÚɯĐÕÊ Ì ×ÛĐÖÕ as well as being the subject of

Éàɯϟ-oxo bridges between the Mn centers[23]. Alternatively, Taguchi et al. (2014) theorized that the OEC could be approximated by a Mn complex in the presence of Ca^{2+} ions[24]. The Ca-OH bond on

Results from this ongoing project has been published in *Life* journal,[25] but to put succinctly, we know the size, morphology, composition, and catalytic water oxidation of the whole-cell BMOs and these were compared to abiotic manganese oxides showing better water oxidizing capabilities.

Investigations into the water oxidizing capabilities will take place by two methods. Specific Aim #1: Culturing MnB1 under various metal concentrations in an effort to improve water oxidation capabilities by incorporation of redox-benign metals. Specific Aim #2: Expression and purification of the multicopper oxidase from the MnB1 gene, *cumA*

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