

LIMITED POWER OF ATTORNEY

The undersigned hereby constitutes and appoints each of Jeffrey T. Walsh and Linda C. Bain, and each of them individually, and with full power of substitution, the undersigned's true and lawful attorney-in-fact to:

(1) Complete and execute for and on behalf of the undersigned, in the undersigned's capacity as an officer, director and/or ten percent (10%) shareholder of bluebird bio, Inc., a Delaware corporation (the "Company") any and all instruments, certificates and documents required to be executed on behalf of the undersigned as an individual or on behalf of the undersigned's company or partnership, as the case may be, pursuant to Section 13 and Section 16 of the Securities Exchange Act of 1934, as amended (the "Exchange Act") or the rules and regulations thereunder;

(2) Do and perform any and all acts for and on behalf of the undersigned which may be necessary or desirable to complete and execute any such instruments, certificates or documents required to be filed pursuant to Sections 13 and 16 of the Exchange Act or the rules or regulations thereunder and timely file such forms with the United States Securities and Exchange Commission and any stock exchange or similar authority; and

(3) Take any other action of any type whatsoever in connection with the foregoing which, in the opinion of such attorney-in-fact, may be of benefit to, in the best interest of, or legally required by, the undersigned, it being understood that the documents executed by any such attorney-in-fact on behalf of the undersigned pursuant to this Power of Attorney shall be in such form and shall contain such terms and conditions as such attorney-in-fact may approve in such attorney-in-fact's discretion.

The undersigned hereby grants to each such attorney-in-fact, acting singly, full power and authority to do and perform any and every act which is necessary, proper or desirable to be done in the exercise of any of the rights and powers herein granted, as fully to all intents and purposes as the undersigned might or could do if personally present, with full power of substitution or revocation, hereby ratifying and confirming all that any such attorney-in-fact, or any such attorney-in-fact's substitute or substitutes, shall lawfully do or cause to be done by virtue of this Power of Attorney and the rights and powers herein granted.

The undersigned acknowledges that each of the foregoing attorneys-in-fact, in serving in such capacity at the request of the undersigned, are not assuming, nor is the Company assuming, any of the undersigned's responsibilities to comply with Section 13 or Section 16 of the Exchange Act or the rules or regulations thereunder. The undersigned hereby agrees to indemnify each attorney-in-fact and the Company from and against any demand, damage, loss, cost or expense arising from any false or misleading information provided by the undersigned to such attorney-in fact.

This Power of Attorney shall remain in full force and effect until the undersigned is no longer required to file any instruments, certificates and documents pursuant to Section 13 and 16 of the Exchange Act or the rules or regulations thereunder with respect to the undersigned's holdings of and transactions in securities issued by the Company, unless earlier revoked by the undersigned in a signed writing delivered to the foregoing attorneys-in-fact.

IN WITNESS WHEREOF, the undersigned has caused this Power of Attorney to be executed as of May 24, 2013.

/s/ Steven Gillis
Steven Gillis, Ph.D.